US009388929B2

(12) **United States Patent**
Lewis et al.

(10) **Patent No.: US 9,388,929 B2**
(45) **Date of Patent: Jul. 12, 2016**

(54) **MALE BAYONET CONNECTOR**

(75) Inventors: **Peter D. Lewis**, Fort Collins, CO (US); **Ravikumar Narayanan**, Fort Collins, CO (US); **Richard W. Cairns**, Longmont, CO (US); **Riley M. Phipps**, Fort Collins, CO (US)

(73) Assignee: **Nordson Corporation**, Westlake, OH (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 782 days.

(21) Appl. No.: **12/976,921**

(22) Filed: **Dec. 22, 2010**

(65) **Prior Publication Data**

US 2011/0204622 A1 Aug. 25, 2011

Related U.S. Application Data

(63) Continuation-in-part of application No. 29/351,665, filed on Dec. 9, 2009.

(60) Provisional application No. 61/289,545, filed on Dec. 23, 2009.

(51) **Int. Cl.**

F16L 37/56	(2006.01)
F16L 37/084	(2006.01)
A61M 39/10	(2006.01)

(52) **U.S. Cl.**

CPC ***F16L 37/56*** (2013.01); ***A61M 39/105*** (2013.01); ***A61M 39/1011*** (2013.01);
(Continued)

(58) **Field of Classification Search**

CPC F16L 37/56; F16L 39/06; F16L 37/565
USPC 285/317, 308
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

163,261 A 5/1875 Ruppenthal
185,896 A 1/1877 Curtis
(Continued)

FOREIGN PATENT DOCUMENTS

BE 479098 1/1948
DE 1868896 3/1963
(Continued)

OTHER PUBLICATIONS

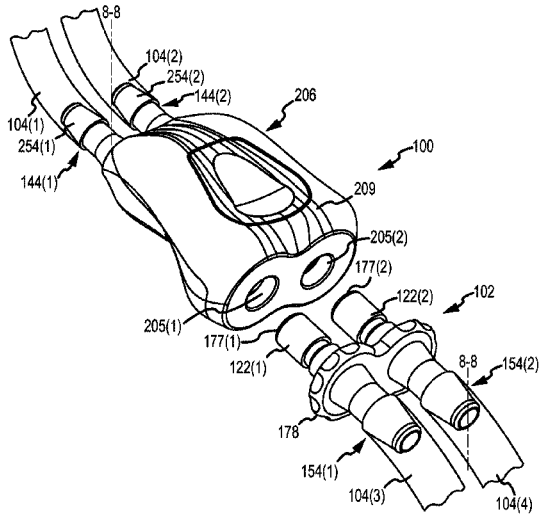
U.S. Appl. No. 29/351,665, filed Dec. 9, 2009, Lewis et al.
(Continued)

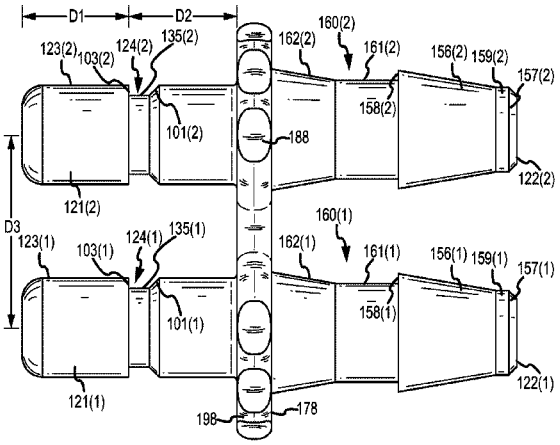
Primary Examiner — David E Bochna
(74) *Attorney, Agent, or Firm* — Baker & Hostetler LLP

(57) **ABSTRACT**

A male bayonet connector connects a section of tubing to a female latch connector. The male bayonet connector includes a shaft defining a lumen, a distal end portion, and a proximal end portion. The distal end portion of the shaft has a sealing surface configured to engage a seal member within the female latch connector to create a fluid-tight seal. The shaft defines an annular recess proximal to and adjacent the distal end portion. The annular recess has a proximal chamfered side wall and a distal sidewall perpendicular to the axis of the lumen, which are separated by a band of smaller diameter than the sealing surface. A grip is formed on the male bayonet connector between the proximal end portion and the annular recess. A ratio of a length of the first sealing surface to a distance between the grip and the distal sidewall is such that a side-load force, as imparted on the male bayonet connector, will not break a fluid-tight seal between the sealing surface and the seal member.

27 Claims, 12 Drawing Sheets





(52) **U.S. Cl.**
CPC ... ***F16L 37/0841*** (2013.01); *A61M 2039/1027* (2013.01); *A61M 2039/1044* (2013.01); *A61M 2039/1083* (2013.01); *A61M 2039/1088* (2013.01)

(56) **References Cited**

U.S. PATENT DOCUMENTS

187,982	A		3/1877	Pirsson et al.	
200,944	A		3/1878	Smith	
235,580	A	*	12/1880	Smith et al.	285/317
327,509	A		10/1885	Aldridge	
584,008	A		6/1887	Munson	
465,868	A		12/1891	List	
707,991	A	*	8/1902	Wareham	285/317
725,421	A		4/1903	Dinkins	
727,982	A		5/1903	Ludwig	
874,957	A		12/1907	Godley	
884,461	A		4/1908	Browne	
909,131	A		1/1909	Antic	
951,889	A		3/1910	Teuer	
D42,368	S		3/1912	Mossberg	
1,029,819	A		6/1912	Nylander	
1,033,187	A		7/1912	Metzger	
1,039,354	A		9/1912	Bonadio	
1,077,417	A		11/1913	McCracken	
1,078,112	A		11/1913	Storm	
1,115,945	A		11/1914	Kunz	
1,115,989	A		11/1914	Thurman	
1,193,446	A		8/1916	Wells	
1,239,345	A		9/1917	Brown	
1,255,847	A		2/1918	Arkin	
1,259,684	A		3/1918	Vinten	
1,489,310	A		4/1924	Critchlow	
1,526,218	A		2/1925	Johnson	
1,578,504	A		3/1926	Bronson et al.	
1,587,079	A		6/1926	Machino	
1,767,073	A		6/1930	Ingold	
1,863,360	A		6/1932	Weatherhead	
1,950,947	A		3/1934	Mulroyan	
2,023,428	A		12/1935	Liebhardt	
2,056,524	A		10/1936	Johnson	
2,066,473	A		1/1937	Jorgensen	
2,097,628	A		11/1937	Liebhardt	
2,099,335	A	*	11/1937	Hansen	285/308
2,108,714	A		2/1938	Hirsch et al.	
2,116,705	A		5/1938	Marx et al.	
2,139,745	A		12/1938	Goodall	
2,147,355	A		2/1939	Scholtes	
2,159,116	A		5/1939	Zacharias	
2,211,147	A		8/1940	Miller	
2,257,321	A		9/1941	Arnold	
2,263,293	A		11/1941	Ewald	
2,264,815	A		12/1941	Thomsen	
2,340,119	A		1/1944	Graham	
2,346,445	A		4/1944	Merker et al.	
2,352,728	A		7/1944	Merker et al.	
2,429,782	A		10/1947	Versoy	
2,432,946	A		12/1947	Theunissen	
2,470,800	A		5/1949	Ashton	
2,479,499	A		8/1949	Le Clair	
2,500,720	A		3/1950	Van der Heem	
2,507,536	A		5/1950	Goodson	
2,516,583	A		7/1950	Moore	
2,535,740	A		12/1950	Knopp	
2,577,009	A		12/1951	Frantz	
2,626,974	A		1/1953	Howard et al.	
2,630,131	A		3/1953	Snyder	
2,661,018	A		12/1953	Snyder	
2,701,147	A		2/1955	Summerville	
2,722,399	A		11/1955	Oetiker	
2,753,195	A		7/1956	Palmer	
2,774,616	A		12/1956	Dodd et al.	
2,790,571	A		4/1957	Flaith et al.	
2,864,628	A		12/1958	Edleson	
2,915,325	A	*	12/1959	Foster	285/319
2,926,934	A		3/1960	Gill	
2,931,668	A		4/1960	Baley	
2,937,892	A		5/1960	Prescott, Jr.	
2,948,553	A		8/1960	Gill et al.	
2,967,067	A		1/1961	Singer	
2,991,090	A		7/1961	De Cenzo	
3,017,203	A		1/1962	Macleod	
3,037,497	A		6/1962	Roberson	
3,046,028	A		7/1962	Nathan	
3,048,415	A		8/1962	Shook	
3,073,342	A		1/1963	Magorien	
3,078,068	A		2/1963	Romney	
D196,473	S		10/1963	Hill	
3,124,157	A		3/1964	Krzewina	
3,129,020	A		4/1964	Bujnowski	
3,171,196	A		3/1965	Helitas	
3,191,628	A		6/1965	Kirkwood et al.	
3,217,400	A		11/1965	Illesy et al.	
3,217,771	A		11/1965	Beall et al.	
3,227,380	A		1/1966	Pinkston	
3,237,974	A		3/1966	Press	
3,245,703	A		4/1966	Manly	
3,276,799	A		10/1966	Moore et al.	
3,279,497	A		10/1966	Norton et al.	
3,314,696	A		4/1967	Ferguson et al.	
3,317,214	A		5/1967	Durgom	
D209,166	S		11/1967	Hunt	
D209,168	S		11/1967	Hunt	
3,352,576	A		11/1967	Thomas	
3,382,892	A		5/1968	Cerbin	
3,394,954	A		7/1968	Sarns	
3,403,930	A		10/1968	Bernier	
3,432,176	A		3/1969	Valenziano	
3,448,760	A		6/1969	Cranage	
3,450,424	A		6/1969	Calisher	
3,512,808	A		5/1970	Graham	
3,523,701	A		8/1970	Graham	
3,538,940	A		11/1970	Graham	
3,542,338	A		11/1970	Scaramucci	
3,545,490	A		12/1970	Burrus	
3,550,626	A		12/1970	Daniels et al.	
3,560,027	A		2/1971	Graham	
3,563,265	A		2/1971	Graham	
3,574,314	A		4/1971	Quercia	
3,588,149	A		6/1971	Demler	
3,596,933	A		8/1971	Luckenbill	
3,599,843	A		8/1971	Johnston	
3,600,917	A		8/1971	Krock	
3,649,050	A		3/1972	Woodling	
3,666,297	A		5/1972	Marks	
3,690,336	A		9/1972	Drum	
3,712,583	A		1/1973	Martindale et al.	
3,747,964	A		7/1973	Nilsen	
3,750,238	A		8/1973	Tanner	
3,815,887	A		6/1974	Curtis et al.	
3,817,561	A		6/1974	Kay	
3,829,135	A		8/1974	Forni	
3,873,062	A	*	3/1975	Johnson et al.	285/317
3,876,234	A		4/1975	Harms	
3,889,710	A		6/1975	Brost	
3,899,200	A		8/1975	Gamble	
3,921,656	A		11/1975	Meisenheimer, Jr. et al.	
3,979,934	A		9/1976	Isenmann	
3,990,674	A		11/1976	Schattenberg	
3,995,659	A		12/1976	Cantore	
4,025,049	A		5/1977	Schmidt	
4,039,213	A		8/1977	Walters	
4,072,330	A		2/1978	Brysch	
4,099,748	A		7/1978	Kavick	
4,113,627	A		9/1978	Leason	
4,116,476	A	*	9/1978	Porter et al.	285/317
4,129,145	A		12/1978	Wynn	
4,142,546	A		3/1979	Sandau	
D252,470	S		7/1979	Pawlak	
4,181,149	A		1/1980	Cox	
4,182,519	A		1/1980	Wilson	
D254,505	S		3/1980	Parsons et al.	
4,200,605	A		4/1980	Imamura	
D255,145	S		5/1980	Nederman	

(56) **References Cited**

U.S. PATENT DOCUMENTS

4,220,360	A		9/1980	Jacek et al.
D258,526	S		3/1981	Nederman
4,253,687	A		3/1981	Maples
D259,278	S		5/1981	McCaw
4,271,865	A		6/1981	Galloway et al.
4,282,175	A		8/1981	Volgstadt et al.
4,287,644	A		9/1981	Durand
4,290,434	A		9/1981	Jewett
4,294,285	A		10/1981	Joslyn
4,296,949	A		10/1981	Muetterties et al.
4,319,774	A		3/1982	Kavick
4,330,010	A		5/1982	Drescher et al.
4,330,142	A		5/1982	Paini
4,331,175	A		5/1982	Brake et al.
4,331,177	A	*	5/1982	Makishima 285/308
4,340,200	A		7/1982	Stegmeier
4,345,786	A		8/1982	Egert
4,346,703	A		8/1982	Dennehey
4,351,351	A		9/1982	Flory et al.
4,366,816	A		1/1983	Bayard et al.
4,393,548	A		7/1983	Herb
4,397,442	A		8/1983	Larkin
4,407,526	A		10/1983	Cicenas
4,431,031	A		2/1984	Ettlinger
4,431,218	A		2/1984	Paul
4,434,121	A		2/1984	Schaper
4,436,125	A		3/1984	Blenkush
4,437,689	A		3/1984	Goebel et al.
4,439,188	A		3/1984	Dennehey
4,458,719	A		7/1984	Strybel
4,489,914	A		12/1984	Stevenson et al.
4,489,961	A		12/1984	Laidig
4,500,118	A		2/1985	Blenkush
4,501,280	A		2/1985	Hood
4,527,745	A		7/1985	Butterfield et al.
4,541,457	A		9/1985	Blenkush
4,541,657	A		9/1985	Smyth
4,553,587	A		11/1985	Traylor
D282,962	S		3/1986	Gerber
4,576,359	A	*	3/1986	Oetiker 285/317
4,580,816	A		4/1986	Campbell et al.
4,603,888	A		8/1986	Goodall et al.
4,603,890	A		8/1986	Huppee
4,613,112	A		9/1986	Phlipot et al.
4,616,859	A		10/1986	Brunet
4,626,001	A		12/1986	Lee
4,630,847	A		12/1986	Blenkush
4,632,436	A		12/1986	Kimura
4,635,972	A		1/1987	Lyall
4,645,245	A		2/1987	Cunningham
4,658,326	A		4/1987	Clark et al.
4,659,116	A		4/1987	Cameron
4,694,544	A		9/1987	Chapman
4,698,027	A		10/1987	Vandame
4,699,298	A		10/1987	Grant et al.
4,700,926	A		10/1987	Hansen
4,703,957	A		11/1987	Blenkush
4,706,847	A		11/1987	Sankey et al.
4,712,280	A		12/1987	Fildan
4,733,890	A		3/1988	Vyse
4,738,401	A		4/1988	Filicicchia
4,753,268	A	*	6/1988	Palau 285/317
4,768,558	A		9/1988	Weber
4,776,067	A		10/1988	Sorensen
4,790,567	A		12/1988	Kawano et al.
4,790,569	A		12/1988	Chaffee
4,792,115	A		12/1988	Jindra et al.
4,793,637	A		12/1988	Laipply et al.
4,806,123	A		2/1989	Konishi et al.
D300,361	S		3/1989	Tokarz
4,824,148	A		4/1989	Grabowski
4,827,921	A		5/1989	Rugheimer
4,832,237	A		5/1989	Hurford, Jr.
4,834,423	A		5/1989	DeLand
4,844,512	A		7/1989	Gahwiler
4,863,201	A		9/1989	Carstens
4,863,202	A		9/1989	Oldford
4,896,402	A		1/1990	Jansen et al.
4,900,065	A		2/1990	Houck
4,903,995	A		2/1990	Blenkush et al.
4,923,228	A		5/1990	Laipply et al.
4,928,859	A		5/1990	Krahn et al.
4,928,999	A		5/1990	Landriault et al.
4,934,655	A	*	6/1990	Blenkush et al. 285/308
4,935,992	A		6/1990	Due
4,946,200	A		8/1990	Blenkush et al.
4,946,204	A		8/1990	Boticki
4,949,745	A		8/1990	McKeon
4,966,398	A		10/1990	Peterson
4,969,879	A		11/1990	Lichte
D313,067	S		12/1990	Kotake et al.
D313,277	S		12/1990	Haining
D314,050	S		1/1991	Sone
D314,233	S		1/1991	Medvick
4,982,736	A	*	1/1991	Schneider 285/319
4,991,880	A		2/1991	Bernart
5,009,252	A		4/1991	Faughn
5,015,014	A		5/1991	Sweeney
5,029,908	A		7/1991	Belisaire
5,033,777	A	*	7/1991	Blenkush 285/317
D319,312	S		8/1991	Schneider
5,052,725	A	*	10/1991	Meyer et al. 285/308
5,074,601	A		12/1991	Spors et al.
5,076,615	A		12/1991	Sampson
5,078,429	A		1/1992	Braut et al.
5,085,472	A		2/1992	Guest
5,090,448	A		2/1992	Truchet
5,090,747	A	*	2/1992	Kotake 285/317
5,094,482	A		3/1992	Petty et al.
5,104,158	A	*	4/1992	Meyer et al. 285/308
5,106,127	A		4/1992	Briet
D326,155	S		5/1992	Boehringer et al.
5,110,163	A		5/1992	Benson et al.
5,112,084	A		5/1992	Washizu
5,114,250	A		5/1992	Usui
D326,715	S		6/1992	Schmidt
5,123,677	A		6/1992	Kreczko et al.
5,143,381	A		9/1992	Temple
5,160,177	A		11/1992	Washizu
5,160,474	A		11/1992	Huff
5,165,733	A		11/1992	Sampson
5,169,161	A		12/1992	Jones
D332,482	S		1/1993	Petty et al.
5,176,406	A		1/1993	Straghan
5,178,303	A		1/1993	Blenkush et al.
5,181,752	A		1/1993	Benson et al.
D333,178	S		2/1993	Novy
5,190,224	A		3/1993	Hamilton
5,201,552	A	*	4/1993	Hohmann et al. 285/308
5,219,185	A	*	6/1993	Oddenino 285/317
5,222,279	A		6/1993	Frano et al.
5,228,724	A		7/1993	Godeau
5,232,020	A		8/1993	Mason et al.
D339,417	S		9/1993	Sampson et al.
5,251,025	A		10/1993	Cooper et al.
5,273,053	A		12/1993	Pohndorf
5,297,820	A		3/1994	Martin
5,297,826	A		3/1994	Percebois et al.
5,316,041	A		5/1994	Ramacier, Jr. et al.
5,318,332	A		6/1994	Hohmann et al.
5,330,235	A		7/1994	Wagner et al.
5,348,051	A		9/1994	Kallenbach
5,348,354	A		9/1994	Badoureaux
5,353,836	A		10/1994	deCler et al.
5,356,183	A		10/1994	Cole
5,374,088	A		12/1994	Moretti et al.
5,385,311	A		1/1995	Morikawa et al.
5,385,331	A		1/1995	Allread et al.
D357,307	S		4/1995	Ramacier, Jr. et al.
5,405,333	A		4/1995	Richmond
5,405,339	A		4/1995	Kohnen et al.
5,405,340	A		4/1995	Fageol et al.
5,411,300	A		5/1995	Mitsui
5,417,442	A		5/1995	Jornhagen

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,421,622 A 6/1995 Godeau
5,437,650 A 8/1995 Larkin et al.
5,440,792 A 8/1995 Ida
5,462,313 A 10/1995 Rea et al.
5,494,074 A 2/1996 Ramacier, Jr. et al.
D369,409 S 4/1996 Salter
5,507,733 A 4/1996 Larkin et al.
5,511,527 A 4/1996 Lorraine et al.
D372,093 S 7/1996 Sampson et al.
5,536,258 A 7/1996 Folden
5,542,712 A 8/1996 Klinger et al.
5,547,166 A 8/1996 Engdahl
5,547,230 A 8/1996 Bank et al.
5,553,895 A 9/1996 Karl et al.
D375,160 S 10/1996 Sampson et al.
5,568,946 A 10/1996 Jackowski
5,595,217 A 1/1997 Gillen et al.
5,601,317 A 2/1997 Crouse et al.
5,607,087 A * 3/1997 Wery et al. 285/317
5,607,190 A 3/1997 Exandier et al.
5,617,609 A 4/1997 Bently
5,620,025 A 4/1997 Lewin
5,628,726 A 5/1997 Cotter
D380,262 S 6/1997 Van Funderburk et al.
5,639,064 A 6/1997 deCler et al.
D382,639 S 8/1997 Musgrave et al.
D384,731 S 10/1997 Ramacier, Jr. et al.
5,681,062 A 10/1997 Fukao et al.
5,682,662 A 11/1997 Coules et al.
5,683,117 A 11/1997 Corbett et al.
D387,147 S 12/1997 Vandermast et al.
5,692,783 A 12/1997 Watanabe et al.
5,695,223 A 12/1997 Boticki
D388,876 S 1/1998 Sampson
5,709,244 A 1/1998 Patriquin et al.
5,725,258 A 3/1998 Kujawski
5,737,810 A 4/1998 Krauss
5,745,957 A 5/1998 Khokhar et al.
5,746,414 A 5/1998 Weldon et al.
5,762,646 A 6/1998 Cotter
5,784,750 A 7/1998 Sankovic et al.
5,799,987 A 9/1998 Sampson
5,820,614 A 10/1998 Erskine et al.
5,837,180 A 11/1998 Linder et al.
5,845,943 A 12/1998 Ramacier, Jr. et al.
5,855,568 A 1/1999 Battiato et al.
5,879,033 A 3/1999 Hansel et al.
5,882,047 A 3/1999 Ostrander et al.
5,884,531 A 3/1999 Koenig
D407,803 S 4/1999 Redman
5,897,142 A 4/1999 Kulevsky
5,911,367 A 6/1999 McInerney
5,911,403 A 6/1999 deCler et al.
5,911,404 A 6/1999 Cheng
5,930,424 A 7/1999 Heimberger et al.
5,937,501 A 8/1999 Imgram
5,938,244 A 8/1999 Meyer
5,941,577 A * 8/1999 Musellec 285/317
5,942,730 A 8/1999 Schwarz et al.
D413,967 S 9/1999 Yuen
5,957,898 A 9/1999 Jepson et al.
5,961,157 A 10/1999 Baron et al.
5,964,485 A 10/1999 Hame et al.
5,965,077 A 10/1999 Rowley et al.
5,975,489 A 11/1999 deCler et al.
5,984,378 A 11/1999 Ostrander et al.
5,988,704 A 11/1999 Ryhman
6,012,743 A 1/2000 Godeau et al.
6,015,171 A 1/2000 Schorn
D419,861 S 2/2000 Khokhar
6,019,348 A 2/2000 Powell
6,024,124 A 2/2000 Braun et al.
6,029,701 A 2/2000 Chaffardon et al.
6,032,691 A 3/2000 Powell et al.
6,041,805 A 3/2000 Gydesen et al.
D422,487 S 4/2000 Khokhar
6,050,297 A 4/2000 Ostrowski et al.
6,076,234 A 6/2000 Khokhar et al.
6,077,245 A 6/2000 Heinrich et al.
6,077,259 A 6/2000 Caizza et al.
6,082,401 A 7/2000 Braun et al.
6,086,044 A 7/2000 Guest
6,089,540 A 7/2000 Heinrichs et al.
6,095,983 A 8/2000 Wawro
6,099,045 A 8/2000 Pirona
6,112,855 A 9/2000 Camacho et al.
6,123,690 A 9/2000 Mejslov
6,129,390 A * 10/2000 Ohlsson 285/317
6,135,150 A 10/2000 Powell et al.
6,135,992 A 10/2000 Wang
6,142,538 A 11/2000 Volgstadt et al.
6,145,896 A 11/2000 Vitel et al.
6,152,914 A 11/2000 Van De Kerkhof et al.
6,155,610 A 12/2000 Godeau et al.
6,161,578 A 12/2000 Braun et al.
6,176,523 B1 1/2001 Winslett
6,182,694 B1 2/2001 Sievers et al.
6,189,560 B1 2/2001 Reynolds
6,199,915 B1 3/2001 Becker
6,199,919 B1 3/2001 Kawasaki et al.
6,199,920 B1 3/2001 Neustadtl
6,206,028 B1 3/2001 Holden et al.
6,221,064 B1 4/2001 Nadal
6,231,089 B1 * 5/2001 DeCler et al. 285/308
D444,054 S 6/2001 Bernard et al.
6,250,688 B1 6/2001 Kirby
6,257,626 B1 7/2001 Campau
6,260,851 B1 7/2001 Baron
6,261,282 B1 7/2001 Jepson et al.
6,293,596 B1 9/2001 Kinder
6,296,508 B1 10/2001 Kuwahara et al.
6,296,796 B1 10/2001 Gordon
6,302,147 B1 10/2001 Rose et al.
6,318,764 B1 11/2001 Trede et al.
6,344,033 B1 2/2002 Jepson et al.
6,382,593 B1 5/2002 deCler et al.
D459,206 S 6/2002 Caveney et al.
6,402,207 B1 6/2002 Segal et al.
6,422,574 B1 7/2002 Mooklar
6,423,053 B1 7/2002 Lee
6,439,620 B1 8/2002 Guest
6,454,314 B1 9/2002 Grosspietsch et al.
6,481,758 B1 11/2002 Andre et al.
6,481,759 B1 11/2002 Kawasaki et al.
6,485,064 B1 11/2002 Davidson
6,485,483 B1 11/2002 Fujii
6,497,433 B1 12/2002 Ketcham
6,505,866 B1 1/2003 Nakamura et al.
6,508,807 B1 1/2003 Peters
6,520,546 B2 2/2003 Szabo
D471,261 S 3/2003 Kozu
6,540,263 B1 4/2003 Sausner
6,543,745 B1 4/2003 Enerson
6,595,964 B2 7/2003 Finley et al.
6,609,696 B2 8/2003 Enerson
6,612,634 B1 9/2003 Zoppas
6,626,419 B2 9/2003 DeCler et al.
6,626,465 B2 * 9/2003 Lacroix et al. 285/317
D481,125 S 10/2003 Hayamizu
6,641,177 B1 11/2003 Pinciaro
6,649,829 B2 11/2003 Garber et al.
6,652,007 B1 11/2003 Hwang
D484,241 S 12/2003 Peters et al.
6,669,681 B2 12/2003 Jepson et al.
6,676,172 B2 1/2004 Alksnis
6,682,547 B2 1/2004 McEwen
D486,909 S 2/2004 Cise et al.
6,688,654 B2 2/2004 Romero
6,692,038 B2 2/2004 Braun
6,695,817 B1 2/2004 Fangrow
6,705,591 B2 3/2004 deCler
6,722,705 B2 4/2004 Korkor
6,722,708 B2 4/2004 Morohoshi et al.
6,762,365 B2 7/2004 Inoue et al.

(56) **References Cited**

U.S. PATENT DOCUMENTS

6,767,017 B2 7/2004 Crapart et al.
D495,050 S 8/2004 Guala
6,783,520 B1 8/2004 Candray et al.
D497,428 S 10/2004 Hayamizu
6,799,747 B1 10/2004 Lai
D498,533 S 11/2004 Hayamizu
6,814,726 B1 11/2004 Lauer
6,840,277 B1 1/2005 Nimberger
6,846,021 B2 1/2005 Rohde et al.
6,848,602 B2 2/2005 deCler et al.
6,848,723 B2 2/2005 Lamich
6,863,314 B2 3/2005 Guest
6,871,669 B2 3/2005 Meyer et al.
6,871,878 B2 3/2005 Miros
D503,778 S 4/2005 Wicks
6,886,803 B2 5/2005 Mikiya et al.
6,897,374 B2 5/2005 Garber et al.
6,899,315 B2 5/2005 Maiville et al.
6,902,144 B2 6/2005 deCler
D507,647 S 7/2005 Beck et al.
6,916,007 B2 7/2005 deCler et al.
6,916,050 B2 7/2005 Milhas
6,926,311 B2 * 8/2005 Chang et al. 285/317
6,929,246 B2 8/2005 Arzenton et al.
6,945,273 B2 9/2005 Reid
6,949,084 B2 9/2005 Marggi et al.
6,962,275 B2 11/2005 deCler et al.
6,978,800 B2 12/2005 deCler et al.
6,981,547 B2 1/2006 Maguire et al.
6,997,486 B2 2/2006 Milhas
6,997,919 B2 2/2006 Olsen et al.
7,005,581 B2 2/2006 Burnette
7,011,342 B2 3/2006 Guivarc'h et al.
7,014,214 B2 3/2006 Kaneko
D522,109 S 5/2006 White et al.
7,040,670 B2 5/2006 Madden
7,044,161 B2 5/2006 Tiberghien
7,044,506 B2 5/2006 Dong
D523,553 S 6/2006 Beck et al.
7,080,665 B2 7/2006 Whall
7,081,223 B2 7/2006 Khoury
7,108,297 B2 9/2006 Takayanagi et al.
7,118,138 B1 10/2006 Rowley et al.
7,128,348 B2 10/2006 Kawamura et al.
7,137,654 B2 11/2006 Segal et al.
7,140,592 B2 11/2006 Phillips
7,147,252 B2 12/2006 Teuscher et al.
7,150,478 B2 12/2006 Poirier et al.
7,153,296 B2 12/2006 Mitchell
7,163,022 B2 1/2007 Whall
D540,944 S 4/2007 Guala
7,210,917 B2 5/2007 Lai et al.
D547,446 S 7/2007 Racz et al.
D550,355 S 9/2007 Racz et al.
D557,409 S 12/2007 Veliss et al.
7,316,428 B2 1/2008 Takayanagi et al.
D564,660 S 3/2008 Hayashi
7,343,931 B2 3/2008 Packham
D567,340 S 4/2008 Tiberghien
7,352,771 B2 4/2008 Garber
D569,507 S 5/2008 Blanchard
D569,955 S 5/2008 Chen
7,377,553 B2 5/2008 Takayanagi
D570,457 S 6/2008 Brown
7,390,029 B2 6/2008 Matsubara
7,394,375 B2 7/2008 Johnson
7,434,842 B2 10/2008 Schmidt
7,434,846 B2 10/2008 Baumgartner
7,448,653 B2 * 11/2008 Jensen et al. 285/308
7,464,970 B2 12/2008 Yamada et al.
7,467,813 B2 12/2008 Gunderson
7,469,472 B2 12/2008 DeCler et al.
7,478,840 B2 1/2009 Youssefifar
7,488,446 B2 2/2009 Meyer et al.
7,494,156 B2 2/2009 Okada
7,503,595 B2 3/2009 McKay
7,516,990 B2 4/2009 Jamison et al.
7,546,857 B2 6/2009 Chadbourne et al.
7,547,047 B2 6/2009 deCler et al.
D595,845 S 7/2009 Miros et al.
D595,846 S 7/2009 Racz et al.
D596,288 S 7/2009 Racz et al.
D596,739 S 7/2009 Ng et al.
7,562,906 B2 7/2009 Schmidt
7,566,077 B2 7/2009 Tsurumi
7,581,763 B2 9/2009 Salomon-Bahls
D602,128 S 10/2009 Williams et al.
7,614,666 B2 11/2009 Eggert et al.
7,631,660 B2 12/2009 deCler et al.
7,647,954 B2 1/2010 Garber et al.
7,666,178 B2 2/2010 McMichael
D612,019 S 3/2010 Williams et al.
D612,021 S 3/2010 Schmidt
7,677,608 B2 3/2010 Takayanagi
D613,853 S 4/2010 Ng et al.
7,695,020 B2 4/2010 Schmidt
7,708,025 B2 5/2010 Johnson
7,731,244 B2 * 6/2010 Miros et al. 285/317
D619,706 S 7/2010 Schon et al.
7,753,415 B2 * 7/2010 Tiberghien et al. 285/308
7,770,939 B2 * 8/2010 Jensen et al. 285/308
7,806,139 B2 10/2010 Packham et al.
7,841,357 B2 11/2010 Rankin
D629,894 S 12/2010 Lombardi, III et al.
7,849,877 B2 12/2010 Tan et al.
D630,320 S 1/2011 Lombardi, III et al.
D632,783 S 2/2011 Maesarapu
7,878,553 B2 2/2011 Wicks et al.
D634,840 S 3/2011 Lombardi, III et al.
D639,398 S 6/2011 Wilhelm
7,954,374 B2 6/2011 Rankin
7,954,515 B2 6/2011 Gerst
D642,244 S 7/2011 Wilhelm
7,976,071 B2 7/2011 Bibby
D645,547 S 9/2011 Lombardi, III et al.
D649,240 S 11/2011 Lewis et al.
D650,478 S 12/2011 Lewis
D652,510 S 1/2012 Lombardi, III et al.
D652,511 S 1/2012 Lombardi, III et al.
D654,573 S 2/2012 Lombardi, III et al.
8,113,546 B2 * 2/2012 Jensen et al. 285/308
D655,393 S 3/2012 Whitaker
D663,022 S 7/2012 Lombardi, III et al.
8,235,426 B2 8/2012 Pisula, Jr. et al.
8,397,758 B2 3/2013 Packham
2001/0017466 A1 8/2001 Braun
2002/0022762 A1 2/2002 Beane et al.
2002/0093192 A1 7/2002 Matkovich
2002/0140172 A1 10/2002 Platusich
2002/0156344 A1 10/2002 Pasricha et al.
2002/0185861 A1 12/2002 Inoue
2003/0004397 A1 1/2003 Kameya et al.
2003/0067162 A1 4/2003 Welsh et al.
2003/0193188 A1 10/2003 Miros
2003/0230894 A1 12/2003 Cleveland et al.
2004/0021318 A1 2/2004 Fritze et al.
2004/0056484 A1 3/2004 Kwon et al.
2004/0094903 A1 5/2004 Sutherland
2004/0195830 A1 10/2004 Gilmour
2004/0199143 A1 10/2004 Lauer
2004/0227346 A1 11/2004 Jamison et al.
2004/0232696 A1 11/2004 Andre
2005/0033237 A1 2/2005 Fentress et al.
2005/0046184 A1 3/2005 Chang
2005/0056121 A1 3/2005 Lyman
2005/0057042 A1 3/2005 Wicks
2005/0082828 A1 4/2005 Wicks et al.
2005/0087981 A1 4/2005 Yamada et al.
2005/0209583 A1 9/2005 Powers et al.
2005/0217265 A1 10/2005 Popp et al.
2005/0242579 A1 11/2005 Bright et al.
2005/0275220 A1 12/2005 Shu
2006/0066100 A1 3/2006 Nakashima et al.
2006/0128180 A1 6/2006 Gammons

(56) **References Cited**

U.S. PATENT DOCUMENTS

2006/0152003	A1	7/2006	Slunick et al.	
2006/0202146	A1	9/2006	Doyle	
2006/0264814	A1	11/2006	Sage	
2006/0293629	A1	12/2006	Cote, Sr. et al.	
2007/0025811	A1	2/2007	Wilhelm	
2007/0029795	A1	2/2007	Moner et al.	
2007/0029796	A1	2/2007	Bibby	
2007/0106213	A1	5/2007	Spera et al.	
2007/0137718	A1	6/2007	Rushlander et al.	
2007/0169825	A1	7/2007	Packham et al.	
2007/0209716	A1	9/2007	Rankin	
2007/0284875	A1	12/2007	Salomon-Bahls et al.	
2008/0007051	A1	1/2008	Jensen et al.	
2008/0011703	A1	1/2008	Schmeisser et al.	
2008/0012314	A1	1/2008	Harger et al.	
2008/0018105	A1	1/2008	Le Bars	
2008/0048448	A1	2/2008	Jamison et al.	
2008/0078464	A1	4/2008	Loewe	
2008/0111371	A1	5/2008	Feger et al.	
2008/0111372	A1	5/2008	Trede et al.	
2008/0129047	A1	6/2008	Blivet et al.	
2008/0164694	A1	7/2008	Zdroik et al.	
2008/0191466	A1	8/2008	Knipple et al.	
2008/0200901	A1	8/2008	Rasmussen et al.	
2008/0277923	A1	11/2008	Brandt et al.	
2008/0277924	A1	11/2008	Jensen et al.	
2008/0284167	A1	11/2008	Lim et al.	
2008/0287920	A1	11/2008	Fangrow et al.	
2009/0079187	A1	3/2009	Malone	
2009/0127847	A1	5/2009	Hagen et al.	
2009/0129047	A1	5/2009	Park et al.	
2009/0140519	A1	6/2009	Pavnaskar et al.	
2009/0167018	A1*	7/2009	Lien	285/308
2009/0187166	A1	7/2009	Young	
2009/0188575	A1	7/2009	Williams et al.	
2009/0256355	A1	10/2009	Wicks et al.	
2010/0001516	A1	1/2010	Pisula, Jr. et al.	
2010/0056975	A1	3/2010	Dale et al.	
2010/0078934	A1	4/2010	Matsunaga	
2010/0185040	A1	7/2010	Uber et al.	
2010/0194100	A1	8/2010	Koch	
2010/0276922	A1	11/2010	Rehder et al.	
2010/0295295	A1	11/2010	Schmidt	
2010/0301599	A1	12/2010	Jensen et al.	
2010/0319796	A1	12/2010	Whitaker	
2011/0012340	A1	1/2011	Packham et al.	
2011/0127767	A1	6/2011	Wicks et al.	
2011/0204621	A1	8/2011	Whitaker et al.	
2011/0204622	A1	8/2011	Lewis et al.	
2011/0210541	A1*	9/2011	Lewis et al.	285/317
2012/0031515	A1	2/2012	Whitaker	
2012/0068457	A1	3/2012	Pisula, Jr. et al.	
2012/0299290	A1	11/2012	Pisula, Jr. et al.	
2012/0299296	A1	11/2012	Lombardi, III	

FOREIGN PATENT DOCUMENTS

DE	3439522		8/1985
DE	3533000		3/1987
DE	4122455		1/1993
DE	4138064	C1	5/1993
DE	19800050		7/1998
DE	102005015343		10/2006
EP	0360634		3/1990
EP	0390746		10/1990
EP	0267067		7/1991
EP	0482277		4/1992
EP	0592823		4/1994
EP	0715111		6/1996
EP	0865779		9/1998
EP	0877891		11/1998
EP	0890054		1/1999
EP	0982525		3/2000
EP	1497582		1/2005
EP	1564469		8/2005
EP	1843074		10/2007
FR	2031965		11/1970
FR	2429370		1/1980
FR	280871		10/2001
FR	2853043		10/2004
FR	2870921		12/2005
FR	2903164		1/2008
GB	583459		12/1946
GB	890775		3/1962
GB	2177769		1/1987
GB	2218166		11/1989
GB	2271157		4/1994
GB	2379253		3/2003
JP	53-006918		1/1978
JP	5-223189		8/1993
JP	7-145889		6/1995
JP	10-169869		6/1998
JP	11-82849		3/1999
JP	2003-42363		2/2003
JP	2003-42368		2/2003
JP	6-512540		4/2006
WO	WO 93/17270		9/1993
WO	WO 95/08732		3/1995
WO	WO 00/79172		12/2000
WO	WO 2004/027269		4/2004
WO	WO 2004/104466		12/2004
WO	WO 2005/064216		7/2005
WO	WO 2006/031958		3/2006
WO	WO 2006/073778		7/2006
WO	WO 2006/084171		8/2006
WO	2006135666	A2	12/2006
WO	WO 2006/135666		12/2006
WO	WO 2007/038222		4/2007
WO	WO 2007/116387		10/2007
WO	WO 2007/120620		10/2007
WO	WO 2008/023021		2/2008
WO	WO 2009/026441		2/2009

OTHER PUBLICATIONS

About Us [online], Thuro Metal Products [retrieved on Apr. 9, 2010], retrieved from the Internet: <URL: http://www.thurometal.com/about.html>, 2 pages.

Barbed Tee Adapter, 1/2 in to 2/8 in to 1/2 in [Item # F1728], http://www.horticulturesource.com/product_info.php/products_id/4016/language/en; dated accessed Sep. 14, 2009, 3 pages.

Brochure, "Precision Components", Value Plastics, Inc., 2002, 132 pages.

Capabilities [online], Jay Manufacturing Corp., retrieved on Apr. 9, 2010, retrieved from the Internet: <URL: http://www.jaymfg.com/capabilities.htm>, 2 pages.

Flojet "Quick Connect" Port System Adapter 90 Elbow Type Quad Port X 1/2" Hose Barb, http://www.amazon.com/Quick-Connect-Port-System-Quad-Barb-90/dp/B0000AZ771/ref=sr_1_16?s=sporting-goods&ie=UTF8&qid=1300220596&sr=1-16, date accessed Sep. 14, 2009; 3 pages.

High-Flow Quick Disconnect Couplings; http://www.coleparmer.com/catalog/product_view.asp?sku=3130355; date accessed Sep. 14, 2009, 3 pages.

Mills, The Process of Vacuum-forming Plastic Parts, IPFrontline.com [online], retrieved on Apr. 9, 2010, retrieved from the Internet: <URL: http://www.ipfrontline.com/depts/article.asp?id=453&deptid=2>, 3 pages.

Nylon, Polypropylene Kynar (PVDF) Plastic Fittings for Flexible Tubing & Hose, http://www.omega.com/pdf/tubing/fittings_tubing_hose/nylon_poly_kynar/nylon.asp; dated accessed Sep. 14, 2009, 2 pages.

Science of Hose Barbs, Colder Products Company, http://www.pddnet.com/article-the-science-of-hose-barbs/, date accessed Sep. 4, 2009, 6 pages.

Stackable Hose Barb Elbow—1/2" CTS x 1/2 ID Barb, http://www.freshwatersystems.com/p-1714-stackable-hose-barb-elbow-12-cts-x-12-id-barb.aspx?affiliatied=10052&utm_source=shopzilla&utm_medium=Feed&utm_campaign=Product&utm_term=3512-1008, date accessed Sep. 14, 2009, 1 page.

(56) **References Cited**

OTHER PUBLICATIONS

Stainless Steel Overview: History [online], Stainless Steel Industry of North America, retrieved on Apr. 9, 2010, retrieved from the Internet: <URL: http://www.ssina.com/overview/history.html>, 1 page.

International Search Report and Written Opinion dated May 23, 2011, PCT/US2010/061896, 11 pages.

Japanese Office Action dated Jul. 9, 2014 for International Application No. 2012-546210, 13 pages.

EP Search Report mailed Jul. 25, 2014 for Application No. 10803324.2-1662, 5 pages.

Japanese Patent Office, "Decision of Refusal dated Jul. 15, 2015", Japanese Patent Application No. 2012-546210, 6 pages.

Singapore Office Action dated Oct. 16, 2014, Application No. 2014/350822389P, 11 pages.

Chinese State Intellectual Property Office (SIPO); Office Action dated May 14, 2015; Chinese Patent Application No. 201080063938.8; 11 pages.

* cited by examiner

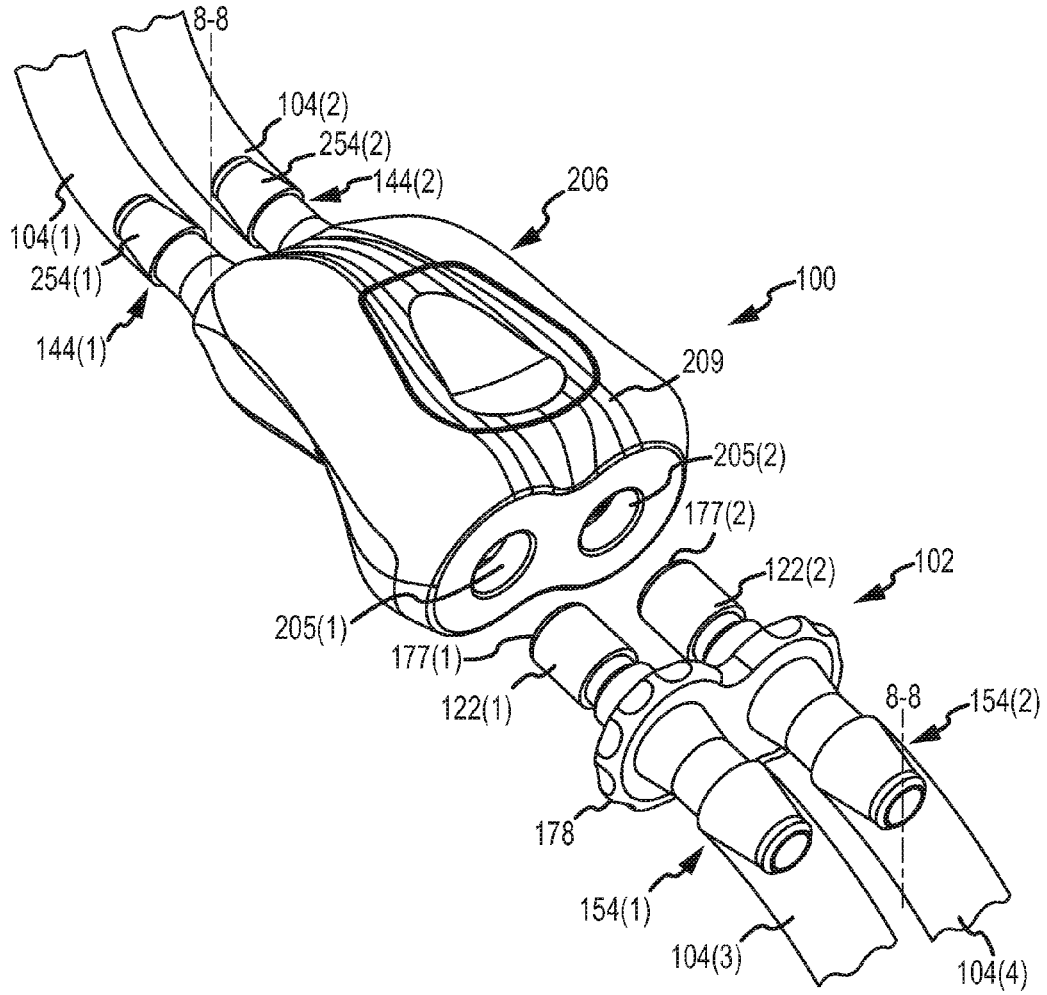

8-8
104(2)
254(2)
144(2)
206
104(1)
254(1)
144(1)
100
209
205(2)
177(2)
122(2)
102
205(1)
177(1)
122(1)
8-8
154(2)
178
154(1)
104(3)
104(4)

FIG.1

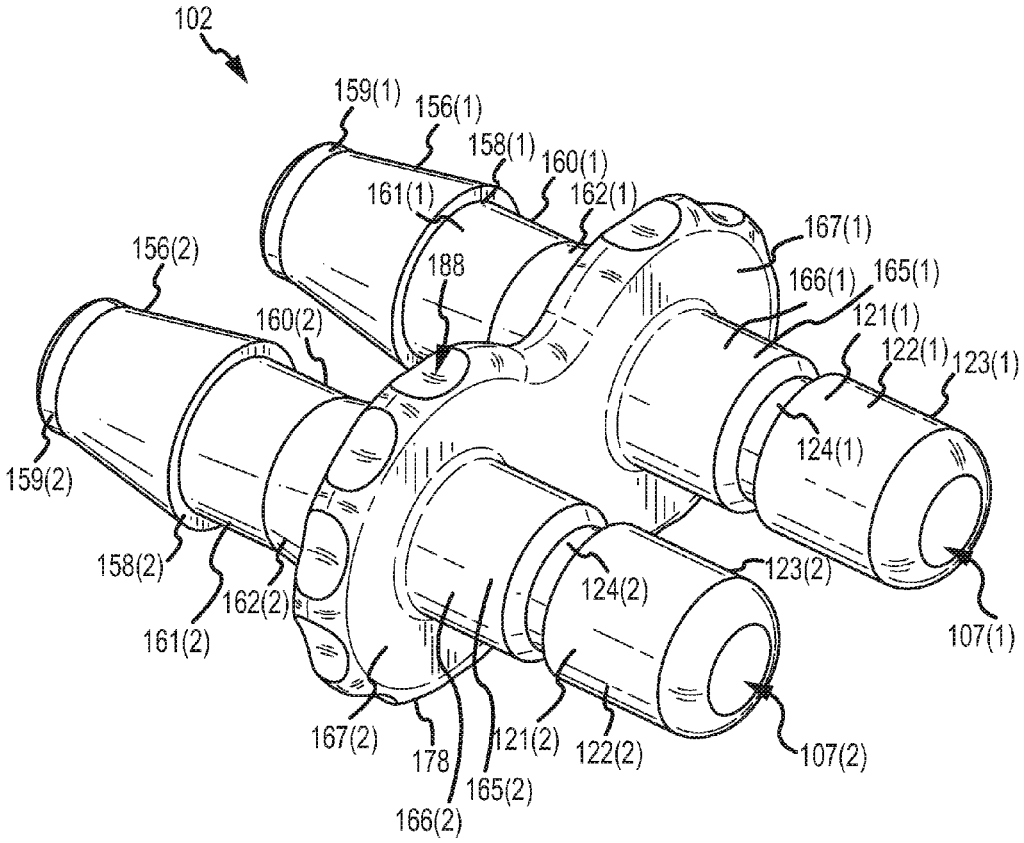

102
159(1)
156(1)
158(1)
160(1)
161(1)
162(1)
167(1)
156(2)
188
166(1)
165(1)
121(1)
160(2)
122(1)
123(1)
124(1)
159(2)
158(2)
162(2)
124(2)
123(2)
161(2)
107(1)
167(2)
178
121(2)
122(2)
107(2)
165(2)
166(2)

FIG.2

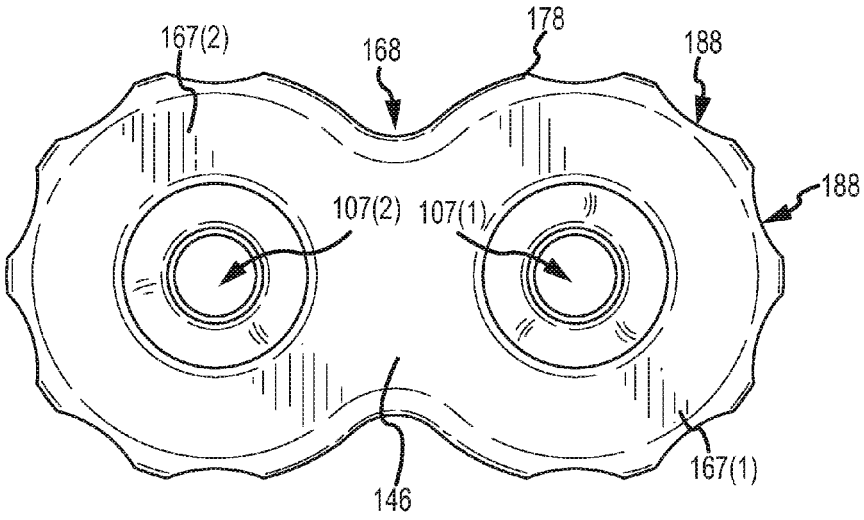

167(2)
168
178
188
188
107(2)
107(1)
167(1)
146

FIG.3

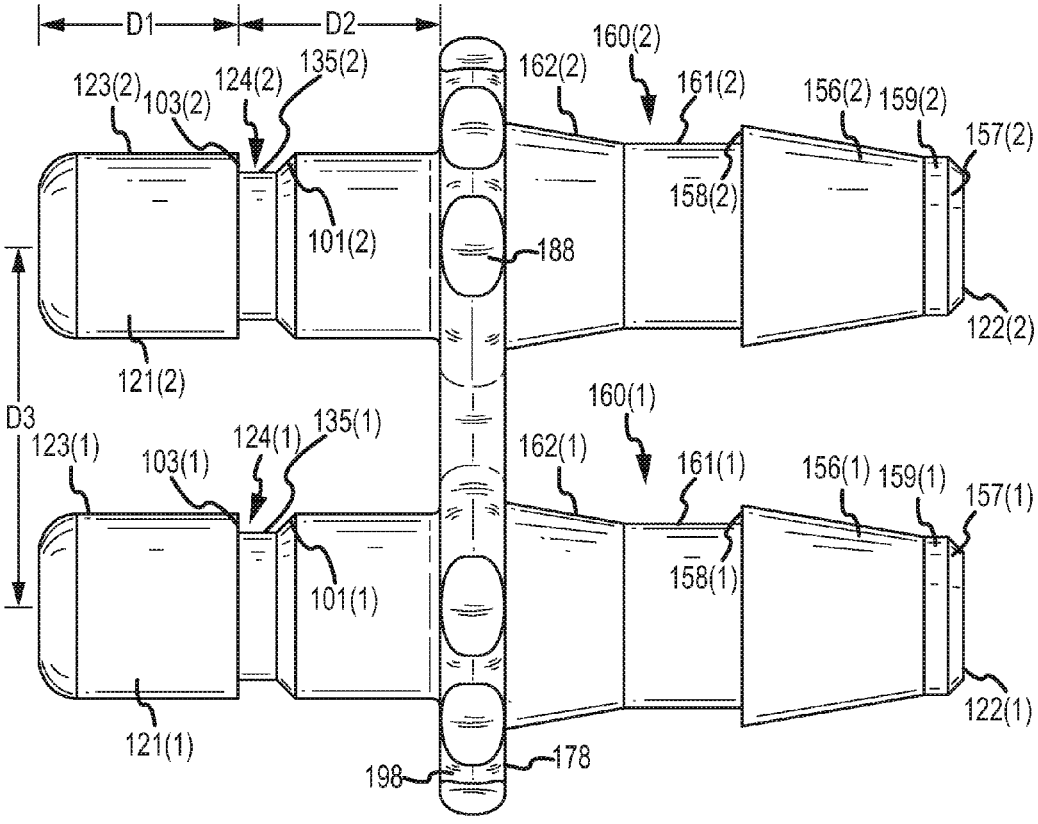

D1
D2
D3
123(2)
103(2)
124(2)
135(2)
101(2)
121(2)
162(2)
160(2)
161(2)
158(2)
156(2)
159(2)
157(2)
188
122(2)
123(1)
103(1)
124(1)
135(1)
101(1)
121(1)
160(1)
162(1)
161(1)
158(1)
156(1)
159(1)
157(1)
122(1)
198
178

FIG.4

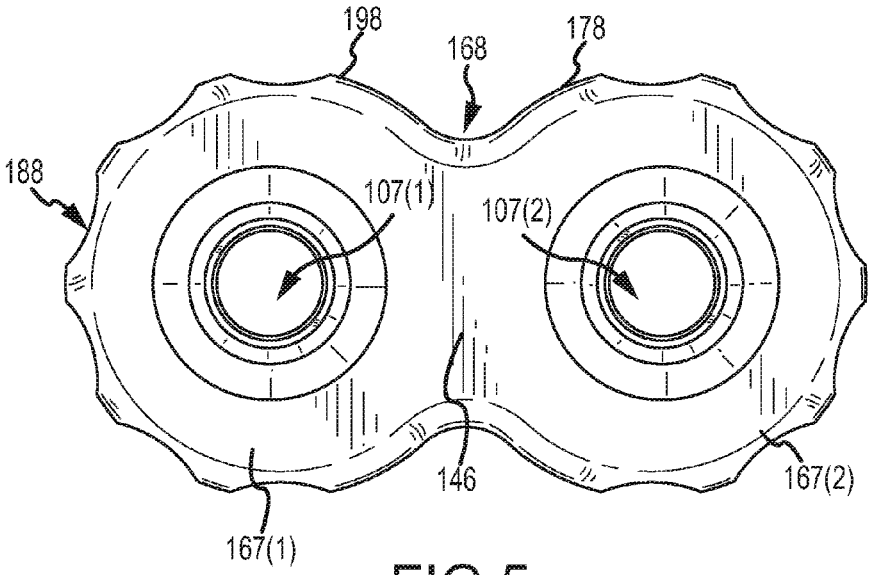

198
168
178
188
107(1)
107(2)
146
167(2)
167(1)

FIG.5

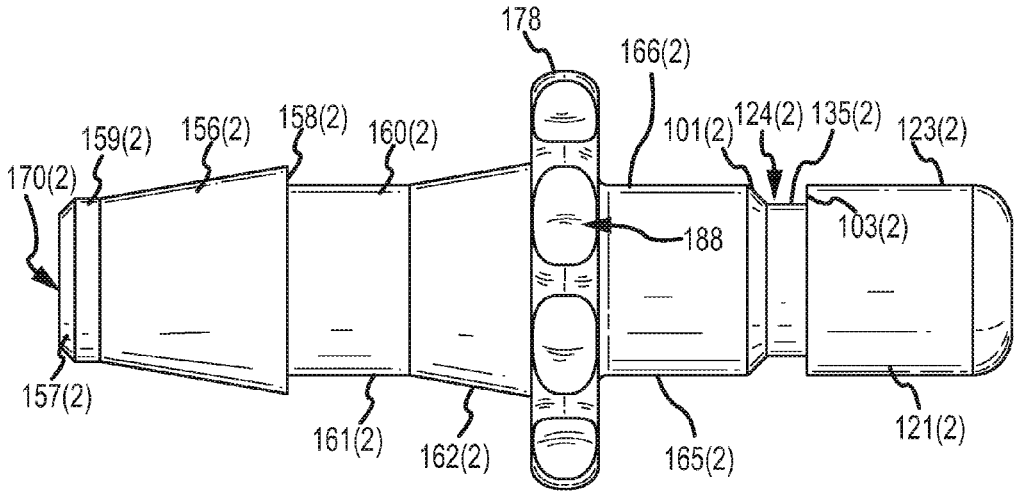

178
166(2)
159(2)
156(2)
158(2)
160(2)
101(2)
124(2)
135(2)
123(2)
170(2)
188
103(2)
157(2)
161(2)
162(2)
165(2)
121(2)

FIG.6

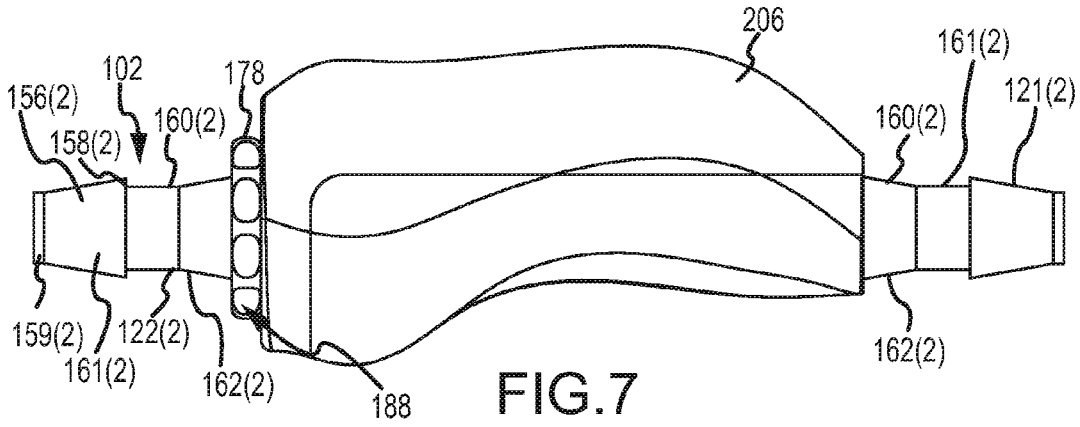

206
161(2)
121(2)
102
178
156(2)
158(2)
160(2)
160(2)
159(2)
161(2)
122(2)
162(2)
188
162(2)

FIG.7

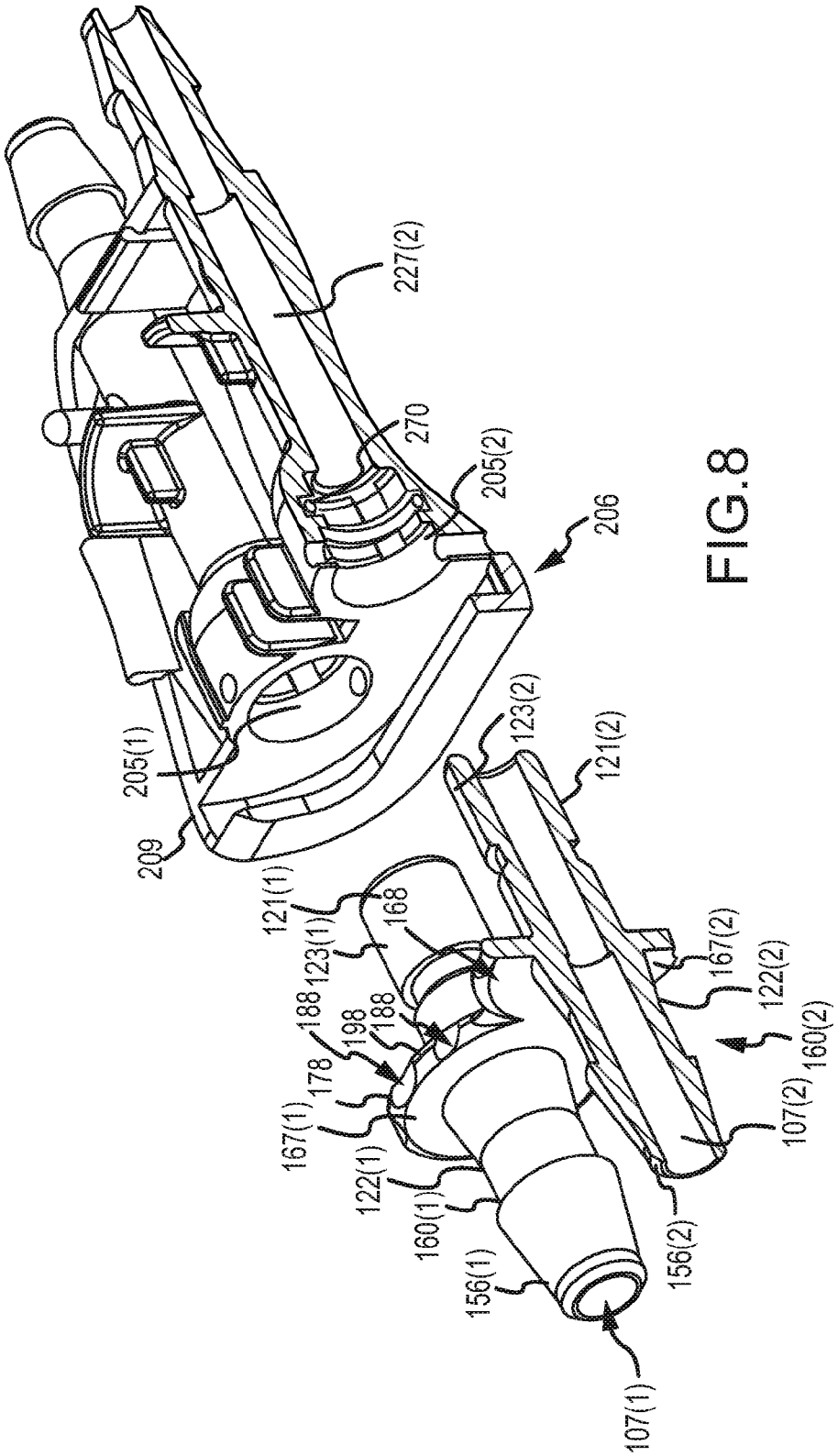

227(2)
270
205(2)
206
205(1)
209
121(1)
123(2)
121(2)
168
123(1)
188
198
188
178
167(1)
122(1)
160(1)
156(1)
107(1)
167(2)
122(2)
160(2)
107(2)
156(2)

FIG.8

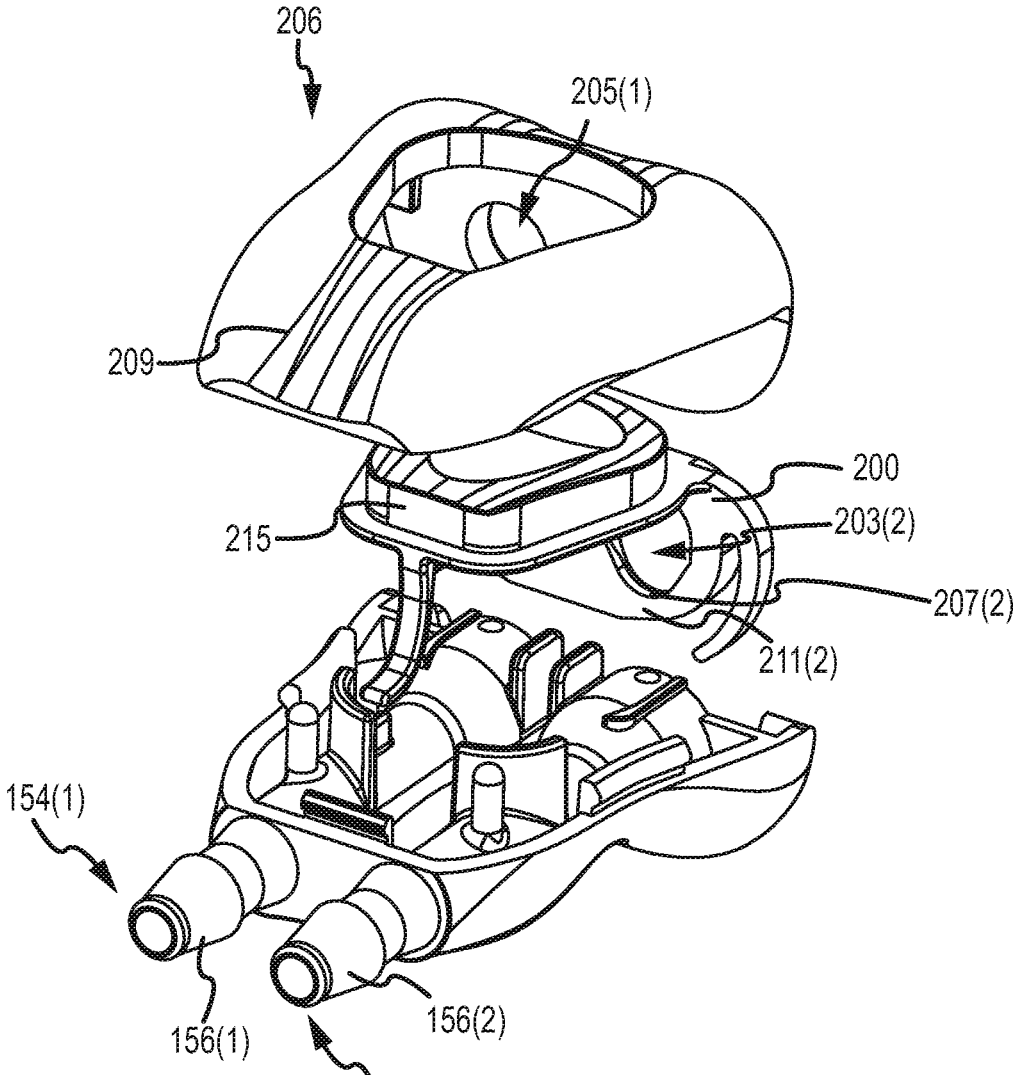


FIG.9

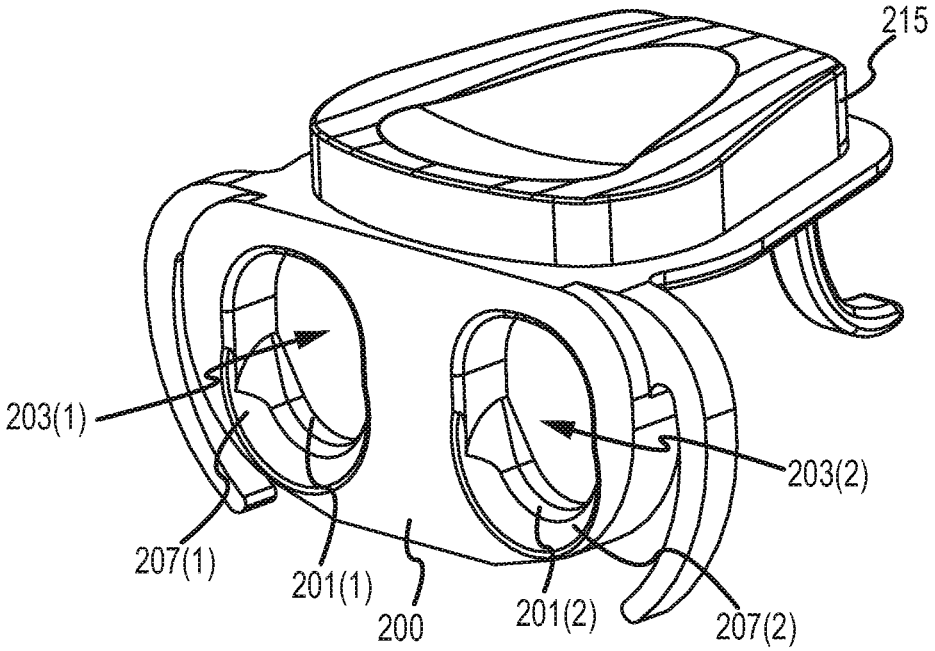


FIG.10

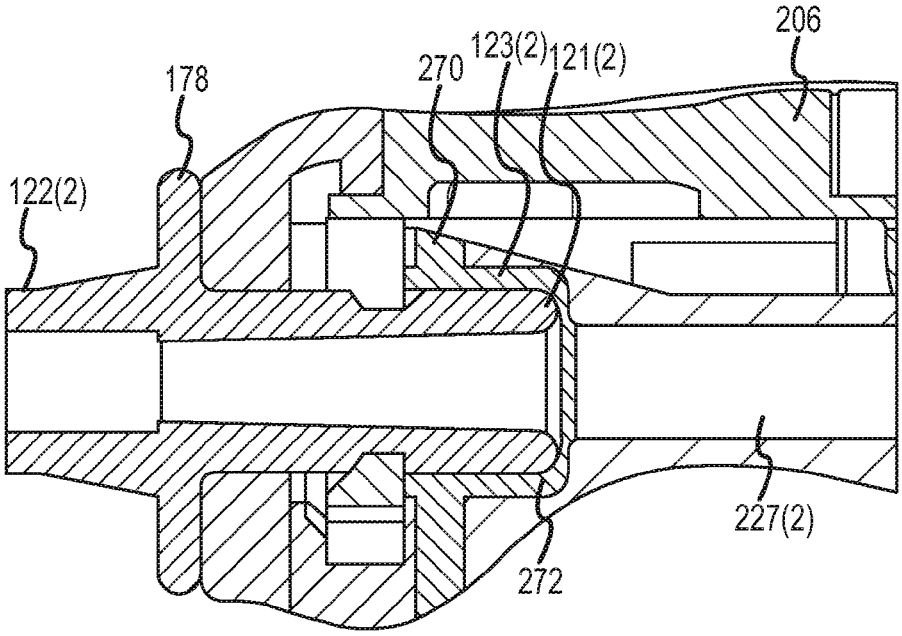

206
123(2)
121(2)
270
178
122(2)
227(2)
272

FIG.11

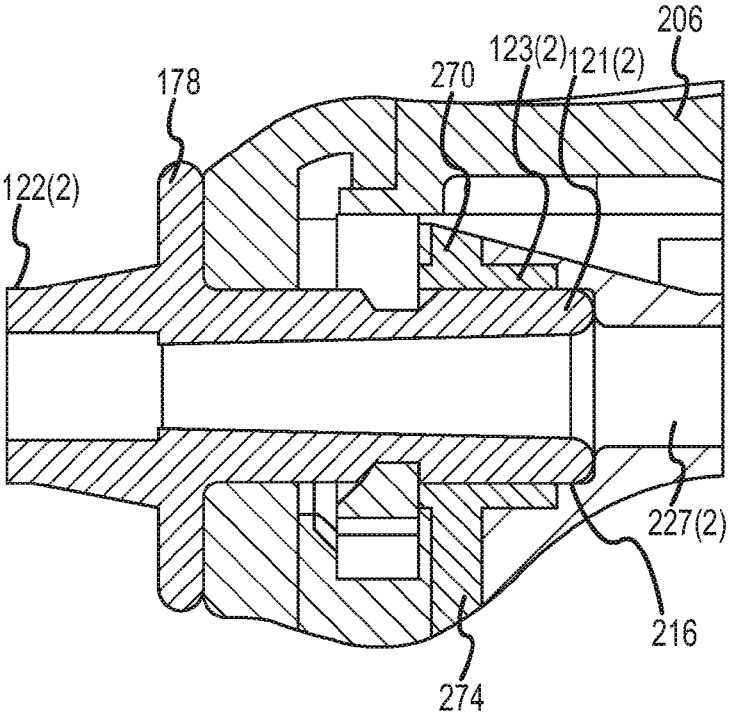

206
123(2)
121(2)
270
178
122(2)
227(2)
216
274

FIG.12

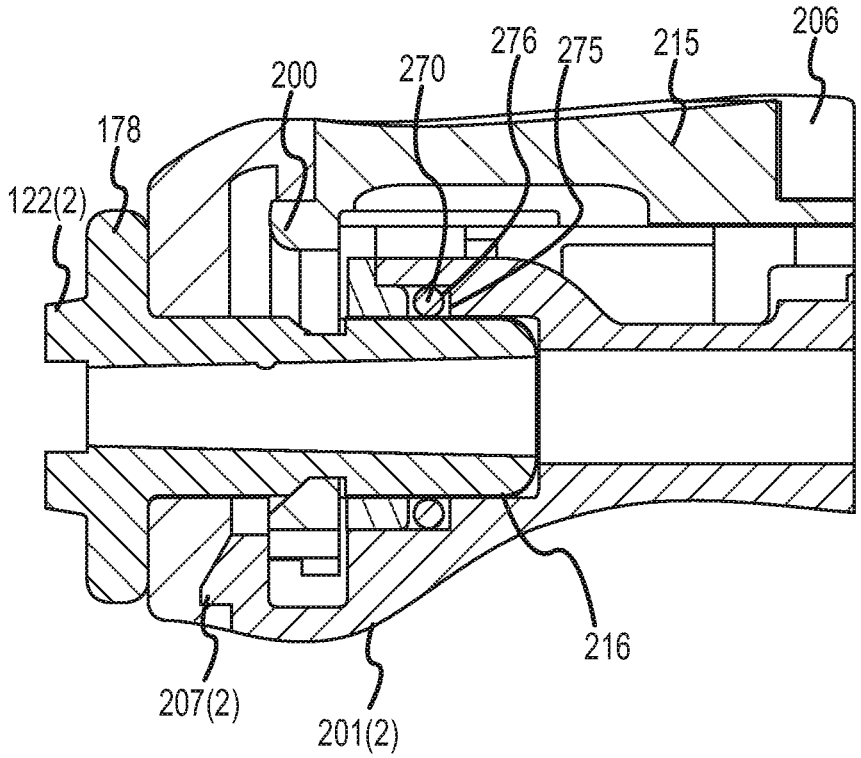


FIG.13

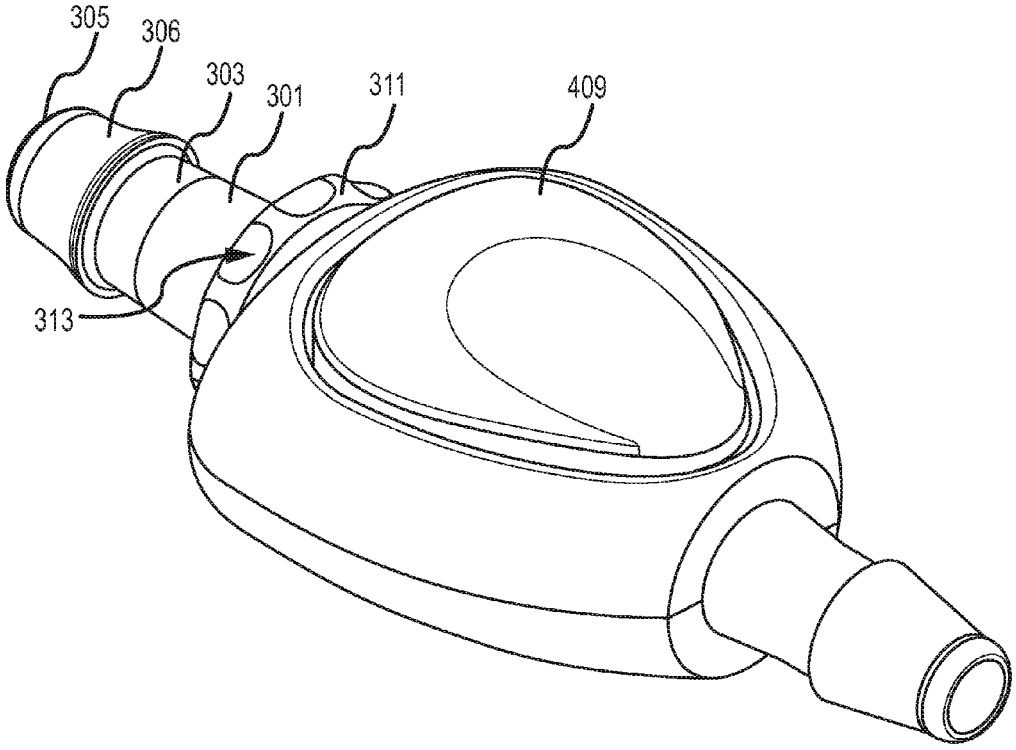


FIG.14

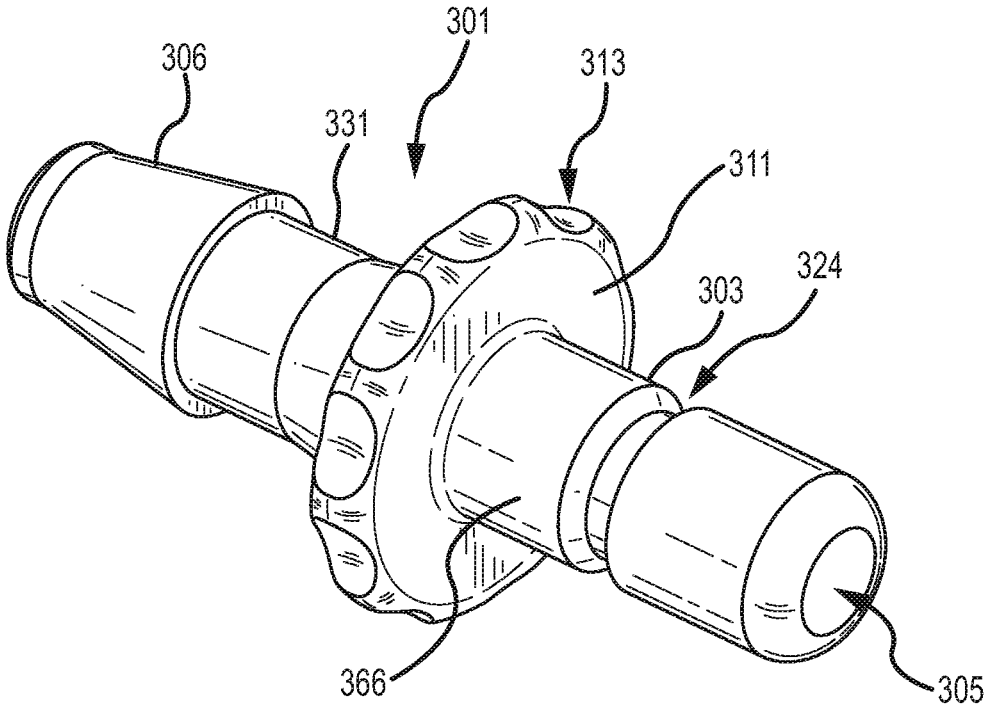


FIG.15

MALE BAYONET CONNECTOR

CROSS REFERENCE TO RELATED APPLICATIONS

This application claims the benefit of priority pursuant to 35 U.S.C. §119(e) of U.S. provisional application No. 61/289,545 filed 23 Dec. 2009 entitled "Male bayonet connector," which is hereby incorporated herein by reference in its entirety. This application is a continuation-in-part of U.S. design patent application Ser. No. 29/351,665 filed 9 Dec. 2009 entitled "Male dual lumen bayonet connector," which is hereby incorporated herein by reference in its entirety.

The present application is related to U.S. patent application Ser. No. 12/976 894 filed contemporaneously herewith entitled "Fluid connector latches profile lead-ins"; U.S. patent application Ser. No. 12/976 943 filed contemporaneously herewith entitled "Button latch with integrally molded cantilever springs"; and U.S. design patent application No. 29/352,637 filed 23 Dec. 2009 entitled "Female dual lumen connector," each of which is hereby incorporated herein by reference in its entirety.

BACKGROUND

1. Technical Field

The present disclosure relates generally to the field of medical devices used for the transport of both gaseous and liquid fluids and more specifically, to a male bayonet connector for creating a releasable air and fluid seal connection between one or more sections of tubing and a female latch connector.

2. Description of Related Art

Tubing sections, for example, medical tubing, must often be joined together to provide for gas and/or liquid fluid flow from one component to another. It is further often desirable to connect and disconnect tubing sections from one another. For example, when a patient's blood pressure is taken with an automatic blood pressure monitor, tubing from the blood pressure cuff (which is generally wrapped around the patient's arm) is connected to the tubing that is connected to the blood pressure monitor. To disconnect the cuff from the blood pressure monitor, it is desirable to merely detach the tubing section connected to the cuff from the tubing connected to the blood pressure monitor. Similarly, when providing intravenous fluids, it is often required to replace an empty fluid bag with a full fluid bag without removing the intravenous needle or stent from the patient. In order to switch between the first fluid bag and the second fluid bag, it is desirable to merely detach a tubing section connected with the fluid bag to the tubing section connected with the needle or stent placed intravenously in the patient, which can then be easily connected with a tubing section connected with the new fluid bag.

Existing tubing connectors are prone to leakage and unwanted disconnection when the patient is still receiving treatment via the connected tubes due to side-loads caused by the weight of the connected tubes and components, as well as accidental pulling of the tubes by the patient or medical personnel.

Furthermore, certain medical devices require the use of multiple tubes for supplying air or fluid between the patient and the device. For example, certain models of blood pressure monitors, such as the Dinamap Procare series, manufactured by General Electric, employ dual tubes for connecting the blood pressure cuff to the monitor. As such, a connector including multiple air passages for directing airflow between the tube segments is desirable, so as to avoid having to individually connect and disconnect multiple connectors when hooking or unhooking a patient to the monitor.

The information included in this Background section of the specification, including any references cited herein and any description or discussion thereof, is included for technical reference purposes only and is not to be regarded subject matter by which the scope of the invention is to be bound.

SUMMARY

A male bayonet connector may include a shaft defining a lumen therethrough and a grip that facilitates gripping of the shaft by the user. The outer surface of the shaft may define a tubing coupling for connecting with a section of tubing, an annular recess or channel that interfaces with a latch in a female connector for connecting the male bayonet connector with the female connector, and a sealing portion that engages a seal member or surface on an inner diameter of a receiving lumen within the female latch connector for creating a fluid seal between the male and female connectors.

In one implementation, a male bayonet connector includes a shaft defining a lumen and having a distal end portion and a proximal end portion. The proximal end portion of the shaft is configured to engage a section of tubing and the distal end portion of the shaft includes a sealing surface configured to engage a seal member on an inner diameter of a receiving lumen in the female latch connector to create a fluid-tight seal. The male bayonet connector further includes a grip that extends around at least a portion of the shaft. The shaft defines an annular recess proximal to and adjacent the distal end portion. The annular recess has a smaller diameter than the outer diameter of the sealing surface of the distal end portion. The annular recess has a proximal chamfered sidewall and a distal sidewall perpendicular to the axis of the lumen of the shaft. A ratio of a length of the sealing surface to a distance the grip and the distal sidewall is such that a side-load force of up to 10 lbs, as imparted on the male bayonet connector, will not break the fluid-tight seal between the sealing surface on the distal end of the shaft and the inner surface of the female receiving structure.

In another implementation, the perpendicular sidewall of the annular channel of the male bayonet connector defines a surface for interfacing with a latch structure within the female receiving structure that resists removal of the male bayonet connector from the female connector.

In another embodiment, the grip extends axially away from the shaft so as to define a flange around the shaft. The flange may define an outer edge and the grip may include a plurality of indentations along the outer edge of the flange for facilitating gripping of the grip.

In other embodiments, the beveled sidewall of the annular channel further defines an angle that is substantially 45 degrees with respect to an axis of the lumen of the shaft. In another embodiment, the ratio of the length of the sealing surface to the distance from the perpendicular sidewall to the grip may be between 0.889 and 1.105.

In another implementation, the male bayonet connector includes two parallel shafts each defining separate lumen and held together by the grip that extends around and between both shafts. The distance between the central axes of the lumen of the parallel shafts may be between 1.695 to 2.035 times the distance from the perpendicular sidewall to the grip.

This Summary is provided to introduce a selection of concepts in a simplified form that are further described below in the Detailed Description. This Summary is not intended to identify key features or essential features of the claimed sub-

ject matter, nor is it intended to be used to limit the scope of the claimed subject matter. A more extensive presentation of features, details, utilities, and advantages of the present invention is provided in the following written description of various embodiments of the invention, illustrated in the accompanying drawings, and defined in the appended claims.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a front isometric view of a male dual bayonet connector, a female latch connector, and tube sections.

FIG. **2** is a rear isometric view of the male dual bayonet connector shown in FIG. **1**.

FIG. **3** is a front elevation view of the male dual bayonet connector shown in FIG. **1**.

FIG. **4** is a top plan view of the male dual bayonet connector shown in FIG. **1**.

FIG. **5** is a rear elevation view of the male dual bayonet connector shown in FIG. **1**.

FIG. **6** is a side elevation view of the male dual bayonet connector shown in FIG. **1**.

FIG. **7** is a side elevation view of the male dual bayonet connector, as connected to a female latch connector shown in FIG. **1**.

FIG. **8** is a rear isometric view of the male dual bayonet connector and female latch connector in cross section of the connecting member taken along line **8-8** of FIG. **1**.

FIG. **9** is an exploded rear isometric view of the female latch connector shown in FIG. **1**.

FIG. **10** is a front isometric view of a latch structure of the female latch connector.

FIG. **11** is a side elevation view in cross-section of another embodiment of the male dual bayonet connector.

FIG. **12** is a side elevation view in cross-section of another embodiment of the male dual bayonet connector.

FIG. **13** is a side elevation view in cross-section of another embodiment of the male dual bayonet connector.

FIG. **14** is a rear isometric view of a male bayonet connector and female latch connector.

FIG. **15** is a rear isometric view of a male bayonet connector.

DETAILED DESCRIPTION

Male bayonet connectors, in conjunction with female latch connectors, may be used to releasably connect sections of tubing. In one embodiment, the male bayonet connector may have a single shaft portion defining a single lumen therethrough and an outer sealing surface that is configured to engage an inner surface of a female latch connector to form a gas and/or liquid fluid seal between the male and female components. The female latch connector may include a latching mechanism that engages a portion of the male bayonet connector so as to prevent removal of the male bayonet connector when connected with the female connector. In another embodiment, the male bayonet connector may have dual shafts, each defining a lumen therethrough. In alternative embodiments, the male bayonet connector may have three or more shafts defining three or more lumen. In embodiments of multiple lumen male bayonet connectors, a grip portion may be used to join the shaft portions, as well as tubing couplings that are configured to engage and retain multiple sections of tubing.

An examplary environment for a male dual bayonet connector **102** is illustrated in FIG. **1**. The environment may include a releasable connection assembly **100** and tubing sections **104(1)-104(4)**. The releasable connection assembly **100** may include the male dual bayonet connector **102** and a female latch connector **206**. The male dual bayonet connector **102** may be connected with the female latch connector **206** as will be described further with respect to FIGS. **11-13**.

Referring to FIG. **1**, first and second tubing sections **104(1)-104(2)** may connect with respective tubing couplings **144(1)-144(2)** on the distal end of the female latch connector **206**. Third and fourth tubing sections **104(3)-104(3)** may connect with respective tubing couplings **154(1)-154(2)** on the proximal end of the male dual bayonet connector **102**. As will be described further below, the male dual bayonet connector **102** may be connected with the female latch connector **206** by inserting the distal end of the male dual bayonet connector **102** into receiving openings **205(1)-205(2)** defined in the proximal end of the female latch connector **206**. The orientations "proximal" and "distal" as used herein have been arbitrarily chosen, and are not meant to limit the present disclosure, but will follow the convention just described with reference to the ends of the female latch connector **206** and male dual bayonet connector **102**.

The male dual bayonet connector **102** is illustrated in greater detail in FIGS. **2-6**. The male dual bayonet connector **102** may include dual shafts **122(1)-122(2)** connected by a grip **178**. The dual shafts **122(1)-122(2)** may extend from the proximal end of the male bayonet connector **102** to the distal end of the connector **102**. As best seen in FIGS. **2**, **3** and **5**, each of the dual shafts **122(1)-122(2)** may define a cylindrical lumen **107(1)-107(2)** for transporting fluid from the third and fourth tubing sections **104(3)-104(4)** coupled with the male dual bayonet connector **102** to the first and second tubing sections **104(1)-104(2)** coupled with the female latch connector **206** via corresponding cylindrical lumens **227(1)-227(2)** defined in the female latch connector **206**. The dual cylindrical lumens **107(1)-107(2)** of the shafts **122(1)-122(2)** may be of substantially uniform diameter throughout the entire length of the dual shafts **122(1)-122(2)** or, as best shown in cross-section in FIG. **3**, may narrow or widen in diameter along the length of the shafts **122(1)-122(2)** to include a smaller diameter section and a larger diameter section. In other embodiments, the diameter of the dual cylindrical lumens **107(1)-107(2)** may be constant. In further embodiments, the portion of lumens **107(1)-107(2)** in the tubing couplings **144(1)-144(2)** may be radially offset with respect to the portion of the lumens **107(1)-107(2)** along the length of the shafts **122(1)-122(2)** to accommodate different tubing configurations. For example, the diameters of the dual cylindrical lumens **107(1)-107(2)** may be larger and/or the tubing couplings **144(1)-144(2)** may be spaced further or closer apart than the dual shafts **122(1)-122(2)** to accommodate varying thicknesses of walls of tubing **104(1)-104(2)**.

The dual lumen configuration of the male dual bayonet connector **102** allows for simultaneously connecting and disconnecting two or more tubes using a single connection assembly, rather than requiring a separate connection assembly for each tube. As such, the male bayonet connector **102** may provide more efficient connecting and disconnecting of tubes by reducing the amount of time required for medical personnel to hook and unhook a patient from medical equipment.

The proximal ends of the dual shafts **122(1)-122(2)** may each include a coupling end **156(1)-156(2)** shaped as a frustum tapering toward the proximal end for coupling with the third and fourth tube sections **104(3)-104(4)** (as seen in FIG. **1**). As best seen in FIGS. **4** and **6**, the coupling ends **156(1)-156(2)** may include a flattened region **159(1)-159(2)** toward the proximal ends of the coupling ends **156(1)-156(2)**, i.e., at the smaller diameter of the frustum. The proximal ends of the

coupling ends **156(1)-156(2)** may further define a chamfered edge **157(1)-157(2)**. The exact angle of the chamfered edge **157(1)-157(2)** may vary. For example, the chamfered edge **157(1)-157(2)** may be between 30-55 degrees. In other embodiments, the proximal ends of the coupling ends **156(1)-156(2)** may be rounded or perpendicular to the flattened region **159(1)-159(2)**. The overall tapered configuration of the coupling ends **156(1)-156(2)**, including the flattened regions **159(1)-159(2)** and chamfered edges **157(1)-157(2)** of the coupling ends **156(1)-156(2)**, may facilitate the insertion of the third and fourth tubing sections **104(3)-104(4)** over the coupling ends **156(1)-156(2)** of the dual shafts **122(1)-122(2)**.

The distal ends of the coupling ends **156(1)-156(2)**, i.e., at the larger diameter of the frustum, may be adjacent to a coupling shaft portion **160(1)-160(2)** that may have a first portion **161(1)-161(2)** having a narrower outer diameter than that of the distal end of the coupling end **156(1)-156(2)**, as well as a second portion **162(1)-162(2)** that gradually widens in outer diameter toward the grip **178**. As such, the coupling shaft portions **160(1)-160(2)** may, in some embodiments, vary in outer diameter along the length of the shafts **122(1)-122(2)**, but in other embodiments, may have a substantially uniform outer diameter that may be narrower than the distal end of the coupling end **156(1)-156(2)**. The difference in outer diameters between the coupling ends **156(1)-156(2)** and the first portions **161(1)-161(2)** of the coupling shaft portions **160(1)-160(2)** may result in an annular shelf that functions as a coupling barb **158(1)-158(2)** for retaining the third and fourth tubing couplings **104(3)-104(4)**.

The distal ends of the shafts **122(1)-122(2)** may define a sealing portion **121(1)-121(2)** including a flattened sealing surface **123(1)-123(2)**. As will be described in further detail below, each sealing surface **123(1)-123(2)** may engage a respective sealing member **270** (as shown in, e.g., FIGS. **11-13**) in the female latch connector **206** to create a fluid-tight seal between the male dual bayonet connector **102** and the female latch connector **206**. The distal end of the sealing portion **121(1)-121(2)** may be rounded, as shown in FIGS. **4**, **2** and **6**, or, in other embodiments, may be chamfered or perpendicular to the sealing surface **123(1)-123(2)**.

The shafts **122(1)-122(2)** may also include proximal portions **165(1)-165(2)** defining a proximal shaft portion **166(1)-166(2)** that extends toward a grip **178**. The proximal shaft portions **166(1)-166(2)** may have the same outer diameter as the sealing portion **121(1)-121(2)**. In one embodiment, the proximal shaft portions **166(1)-166(2)** may have a uniform outer diameter. In other embodiments, the proximal shaft portions may have an outer diameter that is either larger or smaller than the outer diameter of the sealing portion **121(1)-121(2)**.

The shafts **122(1)-122(2)** may also each include an annular channel **124(1)-124(2)** between the proximal portions **165(1)-165(2)** and the sealing portions **121(1)-121(2)** that provides for locking of male dual bayonet connector **102** with the female latch connector **206**. As shown in FIG. **3**, the annular channels **124(1)-124(2)** include a bottom region **135(1)-135(2)** that has a smaller outer diameter than the outer diameter of the sealing portion **121(1)-121(2)**. The distal end of each annular channel **124(1)-124(2)** is bounded by a distal sidewall **103(1)-103(2)** perpendicular to the axes of the cylindrical lumens **107(1)-107(2)**. The depth of the annular channels **124(1)-124(2)** is defined by the difference between the radius of the sealing portion **121(1)-121(2)** and the radius of the bottom region **135(1)-135(2)**.

As best shown in the top and side views of the male dual bayonet connector **102** in FIGS. **4** and **6**, the proximal end of each annular recess **124(1)-124(2)** may be defined by a chamfered or beveled edge **101(1)-101(2)**. The beveled edge **101(1)-101(2)** may define an angle with respect to the axes of the cylindrical lumens **107(1)-107(2)**. For example, the surface defined by each beveled edge **101(1)-101(2)** may form a 45-degree angle with respect to the axes of the cylindrical lumens **107(1)-107(2)**. The beveled edge **101(1)-101(2)** interfaces with the proximal side of the latch plate **200**, which forces the male dual bayonet connector **102** proximally and holds the perpendicular sidewall against the latch plate **200** of the female latch connector **206** in the annular channels **124(1)-124(2)**. This interface reduces movement of the male dual bayonet connector **102** with respect to the female latch connector **206** and thereby reduces wear of the sealing member **207** in the female latch connector **206**. In other embodiments, beveled edges **101(1)-101(2)** may be perpendicular to the axes of the cylindrical lumens **107(1)-107(2)**, may be curved, or alternatively, may define any other angle between 0 and 90 degrees.

The length D**1** of the sealing surfaces **123(1)-123(2)** of the shafts **122(1)-122(2)** as shown in FIG. **3** may bear a relationship to the distance D**2** from the perpendicular sidewall **103(1)-103(2)** of the annular channels **124(1)-124(2)** to the grip **178**. In one embodiment, the ratio of the length D**1** of the sealing surfaces **123(1)-123(2)** to the distance D**2** from the perpendicular sidewall **103(1)-103(2)** to the grip **178** may be such that a side-load force of up to 10 lbs, as imparted on the male bayonet connector **102**, will not break the seal between the sealing surfaces **123(1)-123(2)** and the sealing member **270** in the female connector **206**. For example, in some implementations, the ratio of the length D**1** to the distance D**2** may be between 0.889 to 1.105.

A sealing surface **123(1)-123(2)** that is proportionally substantially the same or longer with respect to the distance D**2** from the annular shelf **103(1)-103(2)** to the grip **178** may provide significant lateral support for the shafts **122(1)-122(2)** when the male dual bayonet connector **102** is inserted into the female latch connector **206**. This proportionality of the length of the shafts **122(1)-122(2)** operates to increase resistance to side-load forces and prevent uneven force distribution along the sealing mechanism **270**, such as when axial forces are applied to either the male dual bayonet connector **102** or the female latch connector **206**. For example, the length of the sealing surface **123(1)-123(2)** may allow for better lead-in alignment of the male dual bayonet connector **102** with the female latch connector **206**. In addition, the length of the sealing surface **123(1)-123(2)**, when interfaced with a comparatively long supporting surface within the female latch connector **206**, may further resist axial movement of the male dual bayonet connector **102** when connected to the female latch connector **206**. The reduction of axial movement of the male dual bayonet connector **102** inside the female latch connector **206** may help resist the sealing member **270** from pinching or slipping off the distal end of the shaft **122(1)-122(2)** and sustain contact between the interior surface of the sealing member **270** and the sealing surface **123(1)-123(2)** to maintain a fluid-tight seal.

The length of the sealing surface **123(1)-123(2)** further allows for positioning the sealing member **270** away from the distal end of the shaft **122(1)-122(2)**, so as to prevent the sealing member **270** from slipping off of the distal end of the shaft **122(1)-122(2)** during engagement of the male dual lumen connector **102** with the female latch connector **206**. For example, when interfacing with a supporting region in the female latch connector **206** that extends past the sealing member **270** toward the distal end of the shafts **122(1)-122(2)**, the engagement of the sealing surface **123(1)-123(2)** and the

female supporting region may resist axial misalignment of the shafts **122(1)-122(2)** under side-loading, thus significantly reducing the possibility of generating a leak path. This serves as an improvement over bayonet designs where the majority of axial support for the shafts is provided at the distal end of the male connector, making these designs much more susceptible to axial and side-loading. Accordingly, the length D1 of the sealing portions **121(1)-121(2)** of the shafts **122(1)-122(2)** may be selected so as to optimize the stability of the male dual bayonet connector **102** when connected with the female latch connector**206**.

The male dual bayonet connector **102** may also include a grip **178**, a portion of which may extend between the dual shafts **122(1)-122(2)** to connect the shafts **122(1)-122(2)** of the connector **102**. In one embodiment, as best shown in FIGS. **7-11**, the grip **178** includes two generally circular flanges **167(1)-167(2)** that surround the shafts **122(1)-122(2)** and that are concentric with the axes of the cylindrical lumens **107(1)-107(2)**. The flanges **167(1)-167(2)** may be connected via a webbed portion **146** formed between the flanges **167(1)-167(2)**, and may have a larger outer diameter than the other portions of the shafts **122(1)-122(2)** of the male dual bayonet connector **102**. As such, the grip **178** may function as a stop for preventing over-insertion of the shafts **122(1)-122(2)** into the female latch connector **206**, and further as a guide for ensuring that the shafts **122(1)-122(2)** are fully inserted into the female latch connector **206**.

As illustrated in FIGS. **7**, **8** and **10**, the webbed portion **146** may define a recessed area **168** between the flanges **167(1)-167(2)** to allow for easy gripping of the male dual bayonet connector **102** when manipulated by a user. In addition to improving the grip of the male dual bayonet connector **102**, providing a recessed area **168** in the webbed portion **146** between the flanges **167(1)-167(2)** may further serve to reduce the amount of material required to manufacture the grip **178**, thereby decreasing the overall cost associated with manufacturing the male dual bayonet connector **102**. In alternate embodiments, there may not be a recessed area between the flanges **167(1)-167 (2)** and the perimeter of the grip **178** may be in the form of an oval track with flat sidewalls.

The webbed portion **146** also provides a further benefit, in that it allows for optimal positioning of the lumens **107(1)-107(2)** of the male dual bayonet connector **102** with respect to one another. In particular, the webbed portion **146** allows for positioning of the lumens **107(1)-107(2)** so that the space between the central axes of the lumens **107(1)-107(2)** can be maximized to allow for convenient connection and removal of both individual and webbed tubes, i.e., tubes connected with an intermediate web along their length, without modifying the tubing. In one embodiment, a distance D3 between the axes of the lumens **107(1)-107(2)** may be between approximately 1.695 to 2.035 times the length D2 between the perpendicular sidewall **103(1)-103(2)** and the grip **178**. Additionally, a wider webbed portion **146** may position the lumens **107(1)-107(2)** further apart and may help prevent tangling of the attached tubing, while a narrower webbed portion **146** would position the lumens **107(1)-107(2)** closer together. A wider webbed portion **146** may alternatively allow for thicker-walled tubing to be attached to the male dual bayonet connector **102** by providing sufficient clearance for thicker tube walls. Accordingly, the width of the webbed portion **146** may be varied according to the specifications of the tubing being attached to the male dual bayonet connector **102**.

Additionally, the outer edge **198** of the grip **178** may include one or more evenly-spaced indentations **188** to further facilitate gripping of the male dual bayonet connector **102** by a user. In the embodiment illustrated in FIGS. **2-6**, the outer edge **198** of the grip **178** includes twelve (12) evenly-spaced indentations **188**, with each ring **167(1)-167(2)** including six (6) indentations **188**, and a recessed webbed portion **146** extending between the rings **167(1)-167(2)**. However, the exact number, shape, and size of the indentations **188** is not critical so long as the grip **178** provides an enhanced gripping surface for the user. As such, in other embodiments, the number, shape, and size of the indentations **188** along the grip **178** may vary.

Another function of the grip **178** is to provide proper lead-in alignment of the male dual bayonet connector **102** with the female latch connector **206**, thereby allowing for proper insertion of the male dual bayonet connector **102** into the female latch connector **206**. Furthermore, the grip **178** ensures axial alignment of the shafts **122(1)-122(2)** with the receiving openings **205(1)-205(2)** of the female latch connector **206** during engagement, so as to allow for even distribution of the pressure applied by the sealing surface **123(1)-123(2)** against the sealing member **270** to prevent leakage around the sealing surface **123(1)-123(2)**, as well as deformation and/or uneven wearing of the sealing member **270** over time.

In a further embodiment, a flat rib (not shown) may extend between the proximal portions **165(1)-165(2)** of the shafts **122(1)-122(2)** to provide greater structural rigidity to the male dual lumen connector **102**. The length and thickness of the rib may vary depending upon design requirements or constraints or with the relative durometer of the material used to form the connector **102**. The rib may or may not be connected to the webbed portion **146** of the grip **178**.

One embodiment of a female latch connector **206** that may be connected to the male dual bayonet connector **102** is illustrated in FIGS. **8-10**. The female latch connector **206** may include an exterior enclosure **209** defining two openings **205(1)-205(2)** for receiving the dual shafts **122(1)-122(2)** of the male dual bayonet connector **102**. As shown in FIG. **7**, the female latch connector **206** may further include a latch plate structure **200** defining two receiving apertures **203(1)-203(2)** that are axially aligned with the exterior openings **205(1)-205(1)** of the assembled female latch connector **206**, so as to receive the shafts **122(1)-122(2)**.

The female latch connector **206** may further define two cylindrical lumens **227(1)-227(2)** that extend through the female latch connector **206**. In one embodiment, the cylindrical lumens **227(1)-227(2)** of the female latch connector **206** are positioned so that when the female latch connector **206** and the male dual lumen connector **102** are connected, the female lumens **227(1)-227(1)** are axially aligned with at least a portion of the male cylindrical lumens **107(1)-107(2)** to facilitate fluid flow between the connected male and female connectors **102** and **206**. In other embodiments, sections of the lumens **107(1)-107(2)** and **227(1)-227(2)** of the male **102** or female **206** connectors may be offset with respect to one another. Additionally, the female latch connector **206** may include two tubing couplings **254(1)-254(2)** that are each configured to engage a section of tubing **104(1)-104(2)**, as shown in FIG. **1**. The tubing couplings **254(1)-254(2)** of the female latch connector **206** may be similar in configuration to the male tubing couplings **156(1)-156(2)**

The latch plate structure **200** of the female latch connector **206** is shown in FIGS. **9** and **10**. As best seen in FIG. **10**, latching surfaces **201(1)-201(2)** may be formed along the bottom walls of the receiving apertures **203(1)-203(2)** of the latch plate structure **200**. In one embodiment, the latch plate **200** may be resiliently biased upward to lift the latching surfaces **201(1)-201(2)** so as to interface with the annular channels **124(1)-124(2)** in the male dual bayonet connector

102. For example, as the shafts 122(1)-122(2) are inserted through the apertures 203(1)-203(2), the latch plate 200 may be biased downward to lower the receiving apertures 203(1)-203(2) to accommodate the outer diameter of the shafts 122(1)-122(2). In one embodiment, the receiving apertures 203(1)-203(2) may each be defined by a chamfered edge 207(1)-207(2) that is angled to facilitate the insertion of the shafts 122(1)-122(2) through the receiving apertures 203(1)-203(2) of the latch structure 200. The distal face of the latch plate 200 may define distal latching edges 211(1)-211(2) that may interface with the annular shelves 103(1)-103(2) of the shafts 122(1)-122(2) to prevent the shafts 122(1)-122(2) from being removed from the female latch connector 206.

The latch surfaces 201(1)-201(2) may be operably coupled to a release mechanism 215 for disengaging the latch surfaces 201(1)-201(2) from the male dual bayonet connector 102. For example, as shown in FIGS. 1, 9 and 10, the release mechanism 215 may be a button that, when depressed, may lower the latch plate 200 so that the latch surfaces 201(1)-201(2) may clear the annular channels 124(1)-124(2), allowing for removal of the shafts 122(1)-122(2) from the receiving apertures 205(1)-205(2) of the female latch connector 206.

The female latch connector 206 may further include a sealing member 270 that engages the sealing surface 123(1)-123(2) of the dual shafts 122(1)-122(2) to form a fluid-tight seal between the female receiving portion 206 and the male dual bayonet connector 102. The sealing member 270 may be made from an elastomeric material that may enhance the sealing interface between the female sealing member 270 and the sealing surface 123(1)-123(2) of the male dual bayonet connector 102.

As best shown in FIGS. 11-13, illustrating the female latch connector 206 connected to the male dual bayonet connector 102, the configuration of the sealing member 270 within the female receiving portion 206 may vary according to different embodiments of the female receiving portion 206. As shown in FIG. 9, in one embodiment, the sealing member 270 may be an over-molded seal 272 that extends along the entire length D1 of the sealing portion 121(1)-121(2) so as to cover the entire sealing surface 123(1)-123(2), as well as forming and end seal with the distal end of the male dual bayonet connector 102. In another embodiment, illustrated in FIG. 10, the sealing member 270 may be an over-molded seal 274 that may cover only a portion of the length D1 of the sealing surface 123(1)-123(2). In yet another embodiment, illustrated in FIG. 11, the sealing member 270 may include an O-ring 276 that has a point contact with the sealing surface 123(1)-123(2). The O-ring 276 may be seated within a recessed area 275 defined by the female latch connector 206.

To connect the male dual bayonet connector 102 with the female latch connector 206, the dual shafts 122(1)-122(2) may be inserted through the openings 205(1)-205(2) (shown in FIG. 1) defined in the exterior enclosure 209 of the female latch connector 206 and the apertures 203(1)-203(2) defined by the latch plate structure 200. Insertion of the shafts 122(1)-122(2) through the apertures 203(1)-203(2) of the latch plate structure 200 causes the latch plate 200 to lower due to the interaction between the rounded distal ends 177(1)-177(2) of the shafts 122(1)-122(2) and the chamfered edges 207(1)-207(2) of the latch surfaces 201(1)-201(2).

Once the shafts 122(1)-122(2) are inserted far enough so that the latch surfaces 201(1)-201(2) are positioned below the annular channels 124(1)-124(2), the latch plate structure 200 may lift so that at least a portion of the latch surfaces 201(1)-201(2) is at least partially seated within the annular channels 124(1)-124(2). As best shown in cross section in FIGS. 9-11, the beveled edges 101(1)-101(2) defined by the annular channels 124(1)-124(2) may be angled to oppose the angle defined by the chamfered edges 207(1)-207(2) of the latch surfaces 201(1)-201(2), thereby preventing lateral movement of the male dual bayonet connector 102 with respect to the connected female latch connector 206.

The distal latching edges 211(1)-211(2) of the latch plate 200 may interface with the perpendicular distal sidewall 103(1)-103(2) of the annular channels 124(1)-124(2) so as to prevent removal of the shafts 122(1)-122(2) from the female receiving portion 206. The perpendicular distal sidewalls 103(1)-103(2) resist disengagement from the latch plate 200 under longitudinal and axial loads. In one embodiment, the distal latching edges 211 (1)-211(2) of the latch face 200 may oppose the perpendicular distal sidewalls 103(1)-103(2) defined in the shafts 122(1)-122(2) to provide a greater axial retention force, as well as the ability to lock the male dual bayonet connector 102 with the female receiving portion 206 from the bottom of the shafts 122(1)-122(2), as opposed to the sides of the shafts 122(1)-122(2). This bottom locking feature further lessens the distance required for lowering the latch plate 200 to release the male dual bayonet connector 102, thereby improving the overall ergonomic design of the female latch connector 206 and minimizing the insertion force required for inserting the male dual bayonet connector 102 into the female latch connector 206.

The elongated sealing surface 123(1)-123(2) of the shafts 122(1)-122(2) may allow for positioning of the sealing mechanism 270 away from the distal end of the sealing surface 123(1)-123(2). As discussed above, this may help prevent the sealing mechanism 270 from pinching or slipping off from the distal end of the shaft 122(1)-122(2), and to sustain contact between the interior surface of the sealing mechanism 270 and the sealing surface 123(1)-123(2) to maintain a fluid-tight seal when axial forces are applied to either of the connected the male dual bayonet connector 102 or the female latch connector 206. In some embodiments, such as when the female latch connector 206 includes an O-ring 276 or partial molded seal 274, the female latch connector 206 may include an additional supporting surface 216 that is positioned around the distal end of the shafts 122(1)-122(2) for providing additional axial support for the shafts 122(1)-122(2), and further preventing deformation of the sealing mechanism 270.

To remove the male dual bayonet connector 102 from the female receiving portion 206, a user may depress the release mechanism 215 to lower the latch plate 200 until the latch surfaces 201(1)-201(2) clear the annular channels 124(1)-124(2). Once the annular channels 124(1)-124(2) are cleared, the male dual bayonet connector 102 may be easily disengaged from the female latch connector 206.

FIGS. 14 and 15 illustrate a single-lumen embodiment of the male bayonet connector 301. In this embodiment, the male bayonet connector 301 may include a single shaft 303, and a single lumen 305 extending through the length of the shaft 303. Similar to the male dual bayonet connector 102, the proximal end of the male bayonet connector 301 may include a coupling end 306 for connecting with a tubing section. The tubing coupling 306 may have a configuration similar to the coupling ends 156(1)-156(2) of the male dual bayonet connector 102 illustrated in FIGS. 2-6. The shaft 303 may further include a coupling shaft portion 331 similar to the coupling shaft portions 160(1)-160(2) of the male bayonet connector 102, and a proximal shaft portion 366 similar in configuration to the proximal shaft portions 166(1)-166(2) of the connector 102. The distal end of the male bayonet connector 301 may include a sealing surface similar to the flattened sealing surface 123(1)-123(2) of the male dual bayonet connector 102 illustrated in FIGS. 2-6, as well as an annular channel 324 that

is configured similar to the annular channels **124(1)-124(2)** of the male dual bayonet connector **102**. In addition, the male bayonet connector **301** may include a ring-shaped grip **311** including a plurality of indentations **313** along the outer edge thereof. In one embodiment, the grip **311** of the male bayonet connector **301** may include ten (10) indentations.

As shown in FIG. **14**, the female connector **409** may include a latch plate structure that is similar to the latch plate structure **200** of the female latch connector **206**. The latch plate of the female connector **209** may include a single aperture for receiving the shaft **303** of the male bayonet connector **301**. Additionally, the female connector **209** may include a sealing mechanism similar to the sealing mechanisms **270** shown in FIGS. **9-11**. When connected, the latch plate may interface with the annular channel of the shaft **303**, and the sealing mechanism may interface with the male sealing surface in a manner similar to that previously described with respect to FIGS. **11-13**. Other embodiments of male bayonet connectors and female latch connectors may include any number of lumens, barbs, and associated shaft portions, as appropriate for the medical procedure being performed.

It will be apparent to those of ordinary skill in the art that variations and alternative embodiments may be made given the foregoing description. Such variations and alternative embodiments are accordingly considered within the scope of the present invention.

As used herein, lumen refers not only to its definition, but also refers to an opening, aperture, or other passageway. The fluid referred to herein can be gaseous, liquid, or other state of material that is flowable through a tube (i.e., granular). In addition, while generally described above as sealed when connected together, the connector structures may be sealed or unsealed. The connection between the male dual bayonet connector and female latch connectors and their respective tube sections can be by means other than a barbed fitting, for example, but not limited to, threaded, press-fit without a barb, John Guest fitting, ferrule, and panel mount.

All directional references (e.g., upper, lower, upward, downward, left, right, leftward, rightward, top, bottom, above, below, inner, outer, vertical, horizontal, clockwise, and counterclockwise) are only used for identification purposes to aid the reader's understanding of the example of the invention, and do not create limitations, particularly as to the position, orientation, or use of the invention unless specifically set forth in the claims. Joinder references (e.g., attached, coupled, connected, joined, and the like) are to be construed broadly and may include intermediate members between a connection of elements and relative movement between elements. As such, joinder references do not necessarily infer that two elements are directly connected and in fixed relation to each other.

In some instances, components are described with reference to "ends" having a particular characteristic and/or being connected with another part. However, those skilled in the art will recognize that the present invention is not limited to components which terminate immediately beyond their points of connection with other parts. Thus, the term "end" should be interpreted broadly, in a manner that includes areas adjacent, rearward, forward of, or otherwise near the terminus of a particular element, link, component, part, member or the like. In methodologies directly or indirectly set forth herein, various steps and operations are described in one possible order of operation, but those skilled in the art will recognize that steps and operations may be rearranged, replaced, or eliminated without necessarily departing from the spirit and scope of the present invention.

The above specification, examples and data provide a complete description of the structure and use of exemplary embodiments of the invention. Although various embodiments of the invention have been described above with a certain degree of particularity, or with reference to one or more individual embodiments, those skilled in the art could make numerous alterations to the disclosed embodiments without departing from the spirit or scope of this invention. Other embodiments are therefore contemplated. It is intended that all matter contained in the above description and shown in the accompanying drawings shall be interpreted as illustrative only of particular embodiments and not limiting. Changes in detail or structure may be made without departing from the basic elements of the invention as defined in the following claims.

What is claimed is:

1. A male bayonet connector for connecting sections of tubing, the male bayonet connector comprising:

a first shaft including a first distal end portion, a first proximal end portion, and a first annular channel proximal to and adjacent the first distal end portion, a first lumen being defined between the first distal end portion and the first proximal end portion; and

a grip attached to at least a portion of the first shaft, wherein:

the first proximal end portion of the first shaft is configured to engage a first section of tubing;

the first distal end portion of the first shaft has a first sealing surface configured to engage a first inner surface of a female receiving structure to create a fluid-tight seal;

the first sealing surface has a constant diameter along a portion of its axial length and extends distally from the first annular channel; and

the first annular channel is defined by a first distal sidewall that is perpendicular with respect to an axis of the first lumen, a first proximal sidewall having a first beveled edge, and a first bottom region connecting the first distal sidewall and the first beveled edge, with the first bottom region being concentric and recessed radially inward with respect to the first sealing surface.

2. The male bayonet connector of claim **1**, wherein the first distal sidewall defines a surface for interfacing with a first latch structure within the female receiving structure so as to prevent removal of the male bayonet connector from the female receiving structure when the first latch structure engages the first annular channel.

3. The male bayonet connector of claim **1**, wherein the grip extends radially away from the first shaft so as to define a flange around the first shaft.

4. The male bayonet connector of claim **3**, wherein the flange defines an outer edge and the grip includes a plurality of indentations along the outer edge of the flange for facilitating gripping of the grip.

5. The male bayonet connector of claim **1**, wherein a ratio of an axial length of the first sealing surface to an axial distance between the first distal sidewall and the grip is between 0.889 and 1.105.

6. The male bayonet connector of claim **1**, wherein a surface of the first beveled edge defines an angle that is substantially 45 degrees with respect to an axis of the first lumen.

7. The male bayonet connector of claim **1**, wherein the grip is positioned to prevent further insertion of the first shaft into the female receiving structure.

8. The male bayonet connector of claim **1**, further comprising:

a second shaft including a second distal end portion, a second proximal end portion, and a second annular

channel proximal to and adjacent the second distal end portion, a second lumen being defined between the second distal end portion and the second proximal end portion, wherein:

the second proximal end portion of the second shaft is configured to engage a second section of tubing;

the second distal end portion of the second shaft has a second sealing surface configured to engage a second inner surface of the female receiving structure to create a fluid-tight seal; and

the second sealing surface has a constant diameter along a portion of its axial length and extends distally from the second annular channel.

9. The male bayonet connector of claim **8**, wherein the grip connects the first and second shafts.

10. The male bayonet connector of claim **9**, wherein the grip extends away from the first shaft so as to define a first flange around the first shaft and extends away from the second shaft so as to define a second flange around the second shaft, and the first and second flanges are connected by a webbed portion therebetween.

11. The male bayonet connector of claim **10**, wherein the webbed portion defines a recessed area between the first and second flanges.

12. The male bayonet connector of claim **10**, wherein the grip defines a larger outer diameter than any other portion of the first or second shafts.

13. The male bayonet connector of claim **8**, wherein a distance between a first central axis of the first lumen and a second central axis of the second lumen is between 1.695 to 2.035 times the distance between the first distal sidewall and the grip.

14. The male bayonet connector of claim **8**, wherein the second annular channel is defined by a second distal sidewall that is perpendicular with respect to an axis of the second lumen, a second proximal sidewall having a second beveled edge, and a second bottom region connecting the second distal sidewall and the second beveled edge, with the second bottom region being concentric and recessed radially inward with respect to the second sealing surface.

15. The male bayonet connector of claim **14**, wherein:

a ratio of a first axial length of the first sealing surface to a first axial distance between the first distal sidewall and the grip is between 0.889 and 1.105; and

a ratio of a second axial length of the second sealing surface to a second axial distance between the second distal sidewall and the grip is between 0.889 and 1.105.

16. The male bayonet connector of claim **15**, wherein:

the first axial length and the second axial length are equivalent; and

the first axial distance and the second axial distance are equivalent.

17. The male bayonet connector of claim **14**, wherein:

a ratio of the axial length of the first sealing surface to a distance between the first distal sidewall and the grip is such that a side-load force of up to 10 lbs, as imparted on the male bayonet connector, will not break the fluid-tight seal between the first sealing surface and the first inner surface of the female receiving structure; and

a ratio of the axial length of the second sealing surface to a distance between the second distal sidewall and the grip is such that a side-load force of up to 10 lbs, as imparted on the male bayonet connector, will not break the fluid-tight seal between the second sealing surface and the second inner surface of the female receiving structure.

18. The male bayonet connector of claim **1**, wherein the grip extends at least a portion of the first shaft.

19. The male bayonet connector of claim **1**, wherein a ratio of the axial length of the first sealing surface to a distance between the first distal sidewall and the grip is such that a side-load force of up to 10 lbs, as imparted on the male bayonet connector, will not break the fluid-tight seal between the first sealing surface and the first inner surface of the female receiving structure.

20. A male bayonet connector for connecting sections of tubing, the male bayonet connector comprising:

a shaft comprising:

a distal end portion defining a sealing surface of constant diameter configured to engage a receiving portion of a female receiving structure;

a proximal end portion configured to engage a section of tubing; and

an annular channel proximal to and adjacent the distal end portion and recessed with respect to the diameter of the sealing surface,

the shaft further defining an axial lumen;

the annular channel further comprising:

a distal sidewall that is perpendicular with respect to an axis of the axial lumen;

a proximal sidewall having a beveled edge; and

a grip extending around at least a portion of the shaft wherein:

the sealing surface has a constant diameter along a portion of its axial length and extends distally from the distal sidewall of the annular channel; and

a ratio of an axial distance between the distal end portion to the distal sidewall and an axial distance between the distal sidewall and the grip is between 0.889 and 1.105.

21. A dual lumen male bayonet connector for connecting sections of tubing to a quick release coupler, the dual lumen male bayonet connector comprising:

a first shaft; and

a second shaft spaced apart from and connected to the first shaft,

each of the first shaft and the second shaft comprising:

a distal sealing portion defining a sealing surface configured to engage a receiving portion of a female receiving structure of the quick release coupler;

a proximal coupling portion configured to engage a section of tubing; and

an annular channel proximal to and adjacent the distal sealing portion,

each of the first shaft and the second shaft further defining an axial lumen;

the annular channel of each of the first shaft and the second shaft comprising:

a distal sidewall that is perpendicular with respect to an axis of the axial lumen;

a proximal sidewall having a beveled edge; and

a bottom region connecting the distal sidewall and the beveled edge that is concentric with and of smaller diameter than the sealing surface,

wherein the sealing surface has a constant diameter along a portion of its axial length and extends distally from the annular channel.

22. The dual lumen male bayonet connector of claim **21**, further comprising a webbed portion formed between the first shaft and the second shaft that connects the first shaft to the second shaft in parallel.

23. The dual lumen male bayonet connector of claim **22**, wherein the webbed portion is proximal to the annular channel.

24. The dual lumen male bayonet connector of claim **22**, wherein a ratio of an axial length of the sealing surface to an

axial distance between the distal sidewall of the annular channel and the webbed portion is between 0.889 and 1.105.

25. The dual lumen male bayonet connector of claim **22**, wherein a distance between central axes of the axial lumen of the first and second shafts is between 1.695 to 2.035 times the distance between the distal sidewall and the webbed portion.

26. The dual lumen male bayonet connector of claim **22**, wherein a ratio of the axial length of the sealing surface to an axial distance between the distal sidewall of the annular channel and the webbed portion is such that a side-load force of up to 10lbs, as imparted on the dual lumen male bayonet connector, will not break a fluid-tight seal between the sealing surface and the receiving portion of the female receiving structure.

27. The dual lumen male bayonet connector of claim **21**, further comprising a rib extending between the first shaft and the second shaft.

* * * * *